2006

Economics of maritime environmental regulations on oil pollution liability : linking theory to practice

Zhirong Tan
World Maritime University

WORLD MARITIME UNIVERSITY
Malmö, Sweden

ECONOMICS OF MARITIME ENVIRONMENTAL REGULATIONS ON OIL POLLUTION LIABILITY: LINKING THEORY TO PRACTICE

By

TAN, ZHIRONG

People's Republic of China

A Dissertation submitted to the World Maritime University in partial Fulfillment of the requirement for the award of the degree of

MASTER OF SCIENCE

In

MARITIME AFFAIRS

(MARITIME SAFETY AND ENVIRONMENTAL PROTECTION)

2006

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature):……..

(Date): …….

Supervised by: **John Liljedahl**
World Maritime University

Assessor: Proshanto K. Mukherjee
Institution/organisation: World Maritime University

Co-assessor: Jingjing Xu
Institution/organisation: University of Wales Swansea

ACKNOWLEDGEMENTS

I can still remember a comment from my course professor Jan-Ake JONSSON, who said that “You are a student from World Maritime University (WMU), which means you are one of the World Most Unique (WMU)”. It seems like an insurmountable task to write a dissertation in such a short period of time complicated by the strict requirements of the academy standards in WMU.

Nevertheless, it was a challenge I accepted to accomplish my promise to my beloved WMU Community. The completion of my work therefore is not simple a personal achievement but a collective contribution from all the people who share their time, knowledge and resources in making this dissertation a reality.

I will to express my most heartfelt gratitude and appreciation to all the kind-hearted people who in one way or the other contributed to the success of this undertaking.

First of all, to all WMU staff who teach me a plenty of maritime knowledge as well as the most valuable field studies. In particular, I wish to thank Ms. Celilia Denne and Ms. Susan Wangeci-Eklow for their untiring efforts and patience to assist me with the references.

To my benefactor, Mr. Feng Zhenglin of the Ministry of Communications (MOC) in China, for his philanthropic support of my 22-month programme at the WMU and his best regards when he came to visit us on July 22, 2006 on behalf of the minister of MOC. Special thanks also to Mr. Ju Chengzhi and Mr. Zhang Xiaojie for their facilitation.

To my Agency, Wuhan University of Technology (WHUT), for allowing me to pursue higher education at WMU. I wish to thank Professor Yan Xinping, Vice President of the WHUT, who gave me a warm support when I aimed to study at WMU. Meanwhile, I appreciate Professor Huang Liwen, Dean of Navigation College,

who afforded a lot of financial support to my family during the period when I studied overseas.

To my former mentor and boss, President Li Yong in Shanghai Maritime Academy and President Wang Jie in Zhejiang International Maritime College, whose strict and astronomical work standards have inspired me to continuously strive for perfection in everything I do.

To my modest supervisor, Johan LILJEDAHL, for his valuable guidance. His kind instruction and specialist knowledge of oil pollution have contributed a lot to my research. His excellent standard of instruction is a most visible source of inspiration for all his students in the university.

To the WMU Governors and all WMU staff, for providing the students with the international standards of maritime education and living services. I wish to express my utmost appreciation to the Maritime Safety and Environmental Protection (MSEP) faculty, particularly to Jan-Ake Johsson for his professional teaching and patient instruction, to Prof. Shuo MA for his kind encouragement of my topic, to Prof. Takeshi NAKAZAWA for his indispensable facilitation of my interviews.

To my friends and classmates, Wang Chao, Zhao Yao, Hao Xiwen, Zhao Yinglei, Fan Zhongzhou, Gu Weihong, Li Haibo, Song Wei and Jin Xi, etc. They have accomplished me to study for a long time in Sweden.

Finally to my beloved father, Mr. Tan Yanlin, who is really like a lighthouse ahead of me. There are also thousands of thanks to my father-in-law and my mother-in-law.

And above all, to my loving Wife, Mrs.Hu Fen and my one-month old daughter, Tan Ermo. You are now the joyful angel in our family.

ABSTRACT

Title of Dissertation: **Economics of Maritime Environmental Regulations on Oil Pollution Liability: Linking Theory to Practice**

Degree: **MSc**

This dissertation is a study of the oil pollution liability regime by analyzing the regulation of tanker-source accident pollution from the perspective of the economic interests in terms of the examining of the key international regulations complied by several countries of the world.

A brief review is made of the historical evolution of the oil pollution liability convention based on the literature review of a various sources as a potential requirement to conduct economics analysis of maritime environmental regulations, in particular to the choice of oil pollution liability policy in one country.

The changes in the world oil seaborne trade, in particular the development of relevant IMO conventions on the oil pollution triggered by increasing occurrences of tanker casualties through the years has echoed a parallel change in tanker accident's rate and oil spill with the change of world tanker fleet.

The legal framework of the oil pollution liability regime is detailed discussed based on the evolution of the international conventions such as CLC/Fund, which bring out some special features, for instance, the property rights in the claims for the environmental damage.

The theoretical framework of economic analysis of oil pollution liability is highlighted, in particular, by the basic economic model of the demand and supply in oil shipping market. In essence, it analyses the relationship between the economic system and the maritime environment system and additionally, the regulation framework that determines the choice of oil pollution liability regime in major oil importing countries of the world. Following this chapter, the liability options among US, Japan and China are addressed.

The final chapter concludes the elasticity of oil supply and demand and the competitiveness of shipping markets are key factors affecting liability policy.

KEYWORDS: Oil Pollution, Economy, Environment

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF OIL SPILLS

Torrey Canyon (1967)

Castillo de Bellver (1983)

ABT Summer (1991)

Argo Merchant (1976)

Amoco Cadiz (1978)

Atlantic Empress (1979)

Antonio Gramski (1979)

Patmos *(1985)*

Exxon Valdez (1989)

Haven *(1991)*

Erika (1999)

*Prestig*e (2002)

LIST OF ABBREVIATIONS

AFS	International Convention on the Control of Harmful Anti-fouling Systems on Ships
BUNKERS	International Convention on Civil Liability for Bunker Oil Pollution Damage
BWM	International Convention for the Control and Management of Ship's Ballast Water and Sediments
CLC	International Convention on Civil Liability for Oil Pollution Damage
CLC 1969	International Convention on Civil Liability for Oil Pollution Damage, 1969
CLC 1992	Consolidated Text of the International Convention on Civil Liability for Oil Pollution Damage, 1992
CMI	Comite Maritime International
COF	Convenient of Flags
CRISTAL	Contract Regarding a Supplement to Tanker Liability for Oil Pollution
CV	Contingent Valuation
Dumping	Convention on the Prevention of Marine Pollution by Dumping of Wasters and Other Matter
EU	European Union
FUND	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage
FUND 1971	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971.
FUND 1992	Consolidated Text of the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992
GNI	Gross National Income

HNS	International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea
IMCO	International Governmental Maritime Consultative Organization
IMF	International Monetary Fund
IMO	International Maritime Organization
INTERVENTION	International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties
ISL	Institute of Shipping Economics and Logistics
ITOPF	International Tanker Owners Pollution Federation Limited
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MB	Marginal Benefit
MDF	Maritime Dependence Factor
MEC	Marginal External Costs
MEPC	Marine Environment Protection Committee
NGOs	Non-Governmental Organizations
NRDA	Natural Resource Damage Assessment
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990
OPA 90	the Oil Pollution Act of 1990
P&I Club	Protection & Indemnity Club
SAR	International Convention on Maritime Search and Rescue
SDR	Special Drawing Rights
SOLAS	International Convention on Safety of Life at Sea
UNEP	United Nations Environment Programme
UNCLOS	United Nations Convention on the Law of Sea, 1982
WTA	Willingness to Accept

CHAPTER 1

1 Introduction

1.1 Background

During the last few decades the oil pollution of the world's oceans has become a matter of increasing international concern[1]. The United Nations concludes that the vast majority of oil pollution is from domestic car oil use and run off from land-based sources, and municipal and industrial waste sites. Nevertheless, the most important pollutant resulting from shipping and maritime activities is oil. According to UNEP research, about 5 percent of oil pollution in oceans is due to tanker accidents[2].

Although this may contribute a comparatively small percentage of the total oil entering the sea in a year, the consequences of an accident can be disastrous to the immediate area, particularly if the tanker involved is a large one and the accident occurs close to the coast. The wrecks of the *Torrey Canyon* (1967), the *Exxon Valdez* (1989), the *Erika* (1999) and the *Prestig*e (2002) are examples. Presently, the oceans remain the primary viaduct for the conduct of world trade. In the long term, the global reliance on oil as the primary source of energy will result in ever-increasing volumes of oil being transported by tankers across the oceans.[3]

In the realm of marine pollution regulation, the most prolific law-making and regulatory body is the London-based International Maritime Organization (IMO), the

[1] The IMO has recognized the vital of oil pollution since 1959. See "*Preventing marine pollution*", focus on IMO, March 1998, at http://www.imo.org.
[2] The UN has also recognized the marine pollution and a research of UNEP in 1990 concludes the different sources to the ocean, at http://www.cep.unep.org/issues/ibsp.html#Oil .
[3] World oil demand grew substantially in the 1990s, even though growth slowed from 2000 to 2002, see Fearnleys 2004, at p.4. For the view that maritime oil pollution can be directly traced to the prominence of petroleum in the industrialised worlds' economies, see B. Shaw et al., *The Global Environment: A Proposal to Eliminate Marine Oil Pollution*, 27 Nat. Resources J. 157 (1987).

United Nations specialised agency tasked with the mandate of regulating maritime safety and marine environmental protection. Indeed, it forms part of that international conventions of environment consciousness which has captured world attention in the past five decades or so and which figures so prominently in the politics of international discourse today. Prevention of ship-source oil pollution has been an international regulatory goal since 1954, giving rise to various conventions, resolutions and codes developed under the auspices of the IMO. Among these regulations, they could be divided into several areas: preventing operational oil pollution like MARPOL 73/78, preventing accidental pollution like SOLAS, reducing the consequence of accidents like OPRC and providing compensation for pollution, such as the CLC, Fund and Supplementary Fund conventions.[4]

As far as maritime environmental regulations on oil pollution liability regime is concerned, only the final area that provides compensation for pollution is concerned in this research. In recent years, the frequent occurrences of tanker oil pollution incidents have raised questions as to whether the compensation standard is suitable for the oil spill damage. Oil compensation standards in maritime transport, as well as in other sectors, are normally subject to specific rules and regulations, such as CLC and Fund. In addition, there regulations are mostly made by national or international governmental organizations rather than by shipping industries themselves or any other professional bodies. As far as who pay the damages is concerned, there are shipowners and cargo owners involved in the oil pollution compensation. First of all, consistent with the 'polluter pays' principle, shipowners are now regarded as the primary polluter by virtue of his direct operational role in transporting cargos that are potential pollutants in the maritime transport sectors. Furthermore, many states have generally sought to shift the costs of environmental compliance to industry. Thus, regulators have tried to impose responsibility on cargo owners based on the argument that the owners of polluting cargoes must share in the costs of preventive and remedial action as well as of compensation to pollution victims.[5]

[4] See Focus on IMO, "*Tanker safety: the work of the International Maritime Organization"*, at http://www.imo.org

[5] See Alan Khee-Jin Tan. "*Vessel-source Marine Pollution*", Cambridge University Publishing, 2006, at p.38.

As far as the oil spill damage scope is concerned, the civil liability regime for marine oil pollution was the first international liability regime to broaden compensation obligations beyond personal injury and property damage provisions to environmental impairment, and has served as a model for liability rule development for the carriage of dangerous goods, the maritime carriage of hazardous and noxious substances, and revisions to civil liability provisions for nuclear damage.[6] Moreover, the method of compensation entitlement under this regime – strict liability – has become the norm for pollution damage liability rules elsewhere. And it has also been rationalized as an effective and equitable means of incorporating the 'polluter pays' principle into the field of environmental liability.[7]

Today, few people would disagree that environment protection is important for maritime transport as well as for quality shipping. However, not many share the same opinion with regard to the environment compensation in the oil pollution damage.[8] Although each regime imposes liability on the shipping sector based on the similar principle that the polluter pays, the liability limit of a responsible party and the definition and scope of pollution damages, especially environmental damage, are the main significant differences. To such extent, any meaningful appraisal of the factors dictating IMO's pollution compensation agenda must take into account the pervasive role of domestic environmental politics.

As to the decision-making process on environmental regulations of the oil pollution liability regime, there are several key actors that should be considered: shipowners, operators, cargo owners, marine insurers, the classification societies, flag states and coast states[9]. In other words, there are two basic aspects: the maritime interests and the environmental interests. Moreover, the international regime is based on the assumption that the liability should be limited. It originates from a compromise

[6] See Sandvik, B., Suikkari, S. "*Harm and reparation in international treaty regimes: an overview*.", in 1997,Wetterstein, P. at pp.57-71.
[7] See Gauci, G.M "*Oil Pollution at Sea- Civil Liability and Compensation for Damage*", John Wiley, Chichester, in 1997, at p.10.
[8] See Gauci,G.M. "*Protection of the marine environmental though the international ship-source oil pollution compensation regime"*. Review of European Community & International Environmental Law 1999: 8(1), at pp29-36.
[9] Alan Khee-Jin Tan, *supra* note 5, at pp.34-74.

among political and economic interests such as developed shipping countries, environmentally conscious coastal countries, the insurance industry, and the oil industry.[10]

As oil pollution from tanker is a hot topic, many experts have done a lot research on the technical and operational regulations as well as the accidents analysis with regard to the development of IMO conventions. However, there is no systematic analysis from the economic point of view. Meanwhile, the liability regime, which consists of international conventions and national legislations, has not been harmonized by many countries. It is necessary for the regulators to have the entire understanding of the cost-benefit analysis in order to achieve the optimal level of the pollution.

So far, Ma emphasized that the maritime environment is an economic issue.[11] Besides that, Alan analyzed the law and politics of international regulation on the vessel-source marine pollution.[12] Xu put forward a theoretical framework of economic analysis of law governing marine pollution.[13] Therefore, the problem is how to describe the economic issues on the oil pollution liability regime. In addition, whether the international regulations are the proper solution to all countries? What are the appropriate types and levels of such regulations and how can they be determined? There are the key questions that the economics of maritime environment regulations on oil liability regime should address and answer.

1.2 Literature Review

There are mainly four types of literatures that relate directly to this research. The first one is a statistic literature dealing with the crude oil trade and tanker accidents.

---

[10] See Michael Mason., "*Transitional Compensation for oil pollution damage: Examining changing Spatialities of Environmental Liability*.", in Marine Policy (2003), at p.2.
[11] See Ma, S., "*Economics of Maritime Safety and Environmental Regulations*". In: Grammenos, C.Th.(ed.): The Handbook of Maritime Economics and Business. London: LLP, 2002, p.400.
[12] *supra* footnote 5, at pp.1-10
[13] See Jingjing, Xu., "*Theoretical Framework of Economic Analysis of Law Governing Marine Pollution*". In WMU Journal of Maritime Affairs, 2006, pp.75-94.

Furthermore, the second one is a legal literature with regard to the development of the oil compensation regime. In addition, the third one is an economic literature dealing with the harmonization of environmental economics and marine regulations. Finally, the last one is a policy literature dealing with the different options on the oil liability of the world.

1.2.1 Statistic Literature

These statistic data aim to describe the world crude oil trade and tanker accidents as well as the oil spill tonnage during the last decades. Meanwhile, the 'Gross National Income' (GNI) level is introduced to assess the relevant factors on the 'Willingness to Accept' (WTA) on the optimal level of pollution. These include Fearnleys review, ITOPF, World Bank, Mikelis,N. and Papanikolaou,A. etc.

'Fearnleys' World Bulk Trades was first issued in 1961 and has since become a world leader on the subject of international seaborne trade in crude oil and dry bulk commodities. In Fearnleys' review 2003 and 2004, crude oil historical trade developments are retrieved to illustrate the crude oil shipping industry. The detailed trade numbers cover the period from 1992 to 2004.[14]

The International Tanker Owners Pollution Federation Limited (ITOPF), which funded by the vast majority of the world's shipowners, is a non-profit making organization responding to oil spills. The number and quantity of oil spills from year1970 to 2004 are collected to show the tanker accidents with regard to the development of the relevant instruments.[15]

In the research of Papanikolaou A, Eliopoulou E, Mikelis N on the casualty analysis of tankers, a three-year period project entitled 'POP&C' provided by the European Commission, concludes that the quantity of spill is relatively stable even though the

[14] See Fearnleys' annual review 2003 and 2004. in Oslo. Fearnelys annual report is the statistic of the world buck trades, which is available at WMU library.
[15] See oil spill statistic, at http://www.itopf.org.

accident rates declined in terms of the investigation of the specified 'AFRAMAX' tankers.[16]

The World Bank publishes the countries' GNI, which is the standard for the division of level of national incomes.[17] Meanwhile, the IOPC Fund supplies the contribution of parties among Fund convention.[18]

1.2.2 Legal Literature

These researches cover the framework of marine pollution conventions from international public law to private law. In particular, the international oil pollution liability law (CLC and Fund) are detailed analyzed by many experts, such as Mukherjee, Gauci, Mason etc. Meanwhile, the IOPC Fund describes the claim manual as well as the guide to the international conventions on liability and compensation for oil pollution damage.

Mukherjee analyzed the law of marine pollution from the broad regimes, which cover the public, regulatory and private laws, and pointed the genuine links among these areas.[19]

Gauci studied the liability and compensation for damage among the oil pollution at sea, which demonstrated in detail the terms and legal judgement with regard to the relevant international conventions.[20]

IOPC Fund published the claim manual to guide the damage claims among the arena of FUND 92 and lists the scope of pollution damage, which gave a various interpretation on the environmental damage.[21]

---

[16] See Dr Nikos Mikelis, "*Tanker safety record at all-time high*", in IMO NEWS 2005(4), at pp.14-16.
[17] See World Bank, "*World Development Report 2004-Making Services Work for Poor People*", at Oxford University Press, at http://www.worldbank.org/data/.
[18] See IOPC Fund Annual Report, at http://www.iopcfund.org.
[19] Dr. Proshanto K. Mukherjee. "*Maritime Legislation*", Malmö: World Maritime University Publishing in 2002, at pp.203-208. In addition, the Law of Marine Pollution lectures at the World Maritime University in 2006.
[20] *supra* footnote 7
[21] *supra* footnote 18.

1.2.3 Economic Literature

The literatures include the principle of environmental economics and methodology of economics of maritime safety and environment economic as well as the theoretical framework of economic analysis of law governing marine pollution.

Hussein systematically studied the basic principles of environmental economics and puts forward the first principle of natural environment.[22] Meanwhile, John Asafu-Adjaye introduced some tools for environmental policy analysis.[23] Above all, Ma introduced the economical principle to the field of maritime safety and environment protection. The optimal pollution level and country's WTA are coincided in case of effective environmental regulations.[24]

Coase examined the problem of social cost by following the economics of welfare.[25] Furthermore, Xu studied the theoretical framework of economic analysis of law governing marine pollution based on the theory-economics of law.[26]

1.2.4 Policy Literature

As for the policy options, there are a number of researches to exam the national strategy or assess the current policy, in particular, in US, Japan and China etc.

Kim gave a comparison analysis between the internal and US regimes regulating oil pollution liability and compensation, which pointed the major different liability options and scope of pollution damage such as the area of environmental damage.[27]

Luo and Lu conducted the crude oil transportation research in China and suggested that the oil compensation regime should be developed.[28]

---

[22] Hussein, M.A,. "Principles of Environmental Economics". In: London, 2004.
[23] John Asafu-Adjaye. "*Environmental Economics for Non-Economists*." World Scientific Publishing Co.Pte.Ltd, in London, 2000.
[24] See *supra* footnote 11, at pp. 415-418
[25] See Coase,R.H. "*The problem of Social Cost"*, from Journal of Law and Economics, in 1960.
[26] See *supra* footnote 13, at p.92.
[27] See Inho Kim, "*A comarison between the international and US regimes regulating oil pollution liability and compensation*", Marine Polciy, 2003 (27),at pp.265-279.
[28] See Hua, Lu."*China's Strategic Oil Reserves and the Establishment of the Oil Spill Contingency System"*. Maritime Economics & Logistics, 2004(6), at pp.349-359

1.3 Objectives

This dissertation attempts to carry out a study of the economics of maritime regulations on oil pollution liability regime and seeks to compare the different liability options among selected countries. The main objective of this research is to analyse the relationship between the economic system and the maritime environment system and additionally, the regulation framework that determines the choice of oil pollution compensation regime in different countries. Especially, the paper is focused on the interaction between tanker shipping industry and maritime environment policy by using the principal economic concepts such as demand and supply, elasticity and monopoly or competitive tanker market etc. Enumerated below are a few broadly defined objectives of the study:

- To study the condition of world oil trade and oil spill accidents as well as the development of international conventions on oil pollution in the International Maritime Organization (IMO).
- To trace the history of maritime environmental regulations on oil liability regime and analyze the special features of property right and externalities of environmental damage.
- To bring out the principle of economics of environment and illustrate the theoretical model on the oil pollution liability regime.
- To compare the different liability choices among US, Japan and China, who are the three biggest oil imports in the world and find the major contributions to the determination of oil liability policy.

1.4 Methodology and Limitation

The design of this research is primarily based on data collection, documentary review and comparative analysis.

Considerable emphasis has been placed on data digging by collection various data from crude oil shipping, oil spill accidents and gross national income etc. Most of these materials come from official report or review and some of them are obtained from journals and other academic researches.

The documentary review follows a chronological process of the various instruments are provided, detailing how the interest politics of the relevant state have come to influence the regime formation process and its effectiveness in dealing with the oil pollution liability in tanker shipping.

The scope of economics of maritime regulations on the oil pollution liability regime is a broad topic. However, this dissertation restricts its focus on the liability regime. Meanwhile, the oil here refers mainly to the crude oil carried by tanker. Finally, only the typical countries, such as US, Japan, China, are selected to analyze the policy options.

1.5 Structures of the Dissertation

The research is presented in six chapters. Chapter 1 presents the background and objectives of this research based on the literature review. In chapter 2, crude oil seaborne trade is analyzed with the development of tanker fleet as well as the oil spill accidents. It presents a whole understanding of the background of international conventions. In chapter 3, the international conventions are detailed discussed. Chapter 4 demonstrate how economic principles are supposed to work under maritime environmental law. In addition, the theoretical framework of economic analysis on regulation options is addressed. In Chapter 5, the case study brings out a clear comparative liability options among US, Japan and China. Finally, chapter 6 concludes with an assessment of economic methods on maritime environmental regulations on the oil pollution liability and their policy implications as well as some limitation of this research.

CHAPTER 2

2 Crude Oil Seaborne Trade and Oil Spills

The principal purpose of most oil liability regime is related to the oil spills of tankers, so it is essential to have a basic understanding of crude oil seaborne trade, tanker fleet, and, in particular, overall tanker accidents and oil spills. Tanker accidents and marine environmental conventions are interrelated, each at times typical accidents influencing the characteristics of the IMO conventions. In this research, we only concentrate on the crude oil seaborne trade.[29]

This chapter first presents the features of crude oil seaborne trade, followed by some brief historical data of trade as well as the development of the tanker fleet. Moreover, the historical oil spills are described with the cause-consequence analysis in terms of selected tanker type. Lastly, a brief list of the relevant IMO conventions are given, which influenced the tanker safety in the last decades.

2.1 Crude Oil Seaborne Trade

2.1.1 Crude Oil Transport

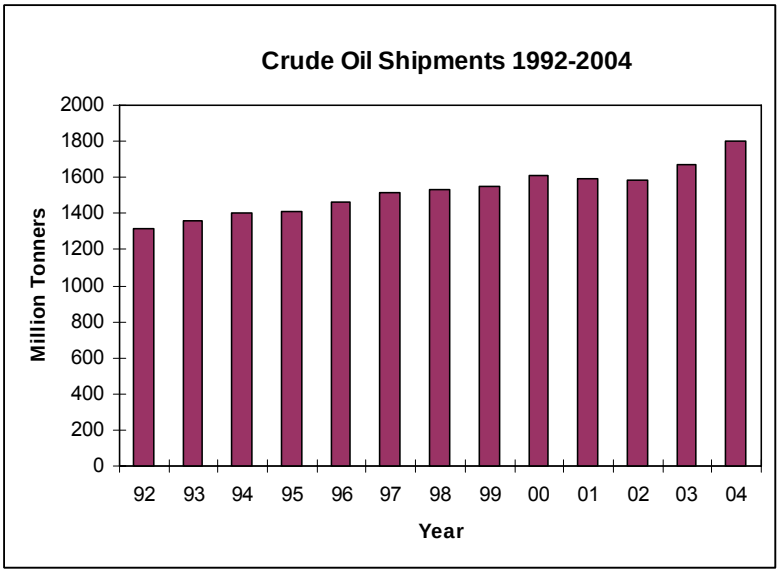
The crude oil seaborne trade plays a very important role in the world seaborne trade.[30] According to the statistics of Fearnleys, in 1992, the world seaborne trade was of 4,221 million tons, among which 1,313m tons were crude oil. The volume increased in 2002 to 5,820m tons and the volume of crude oil was 1,588m tons. In 2003, of this total 6,133m tons world seaborne trade, about 27% or 1,673 million

[29] This restrictive definition of '*persistent oil'* here only refers to crude oil because of the information limited by this research. In essence, 'oil' shall confined to any persistent oil such as crude oil, fuel oil, lubricating oil and whale oil under the scope of CLC/Fund conventions.
[30] See Shuo, M. , "*Demand of Maritime Transport"* in Maritime Economics (2005), unpublished course lectures at the World Maritime University, Malmö, Sweden, at p.15.

tons were crude oil and another 440 million tons of oil products were transport by tankers.[31] The majority of tanker cargo is oil, which includes crude oil (80%) and oil products (20%). [32]

The Figure 1 shows the development of the crude oil seaborne trade from 1992 to 2004 all over the world. Thus, we could conclude that the world crude oil seaborne trade maintain a big amount and increased slowly, for instance, there is a slight decrease during the period from year 2000 to 2002.

Figure 1: Crude Oil Seaborne Trades 1992-2004



(Source: Compiled from *Fearnleys* Review 2004 and 2005)

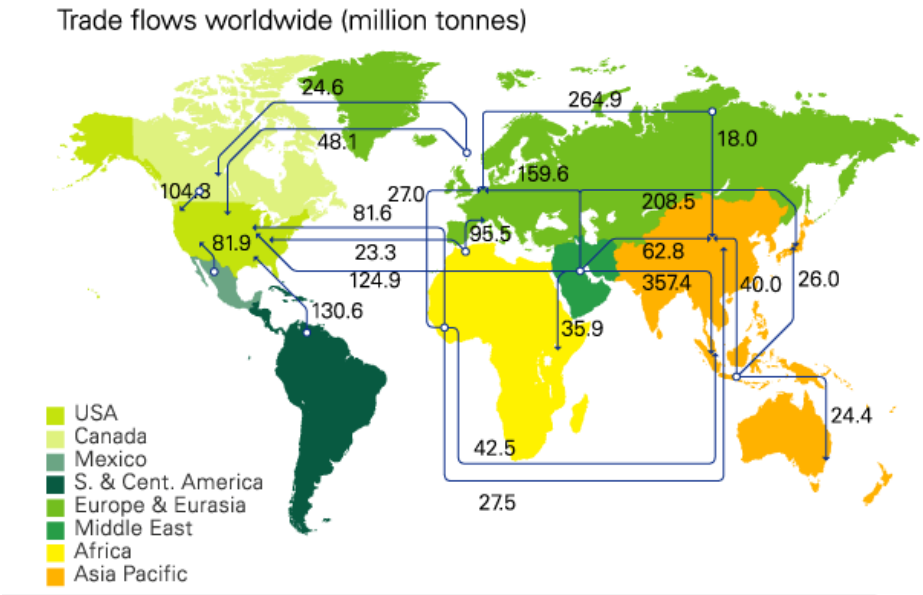
Generally, the transport of crude oil follows the same pattern of the industrial production and economic activities measured by GDP.[33]The major reason that crude oil has been the biggest single commodity in maritime transport is not only that it is a principle source of energy, it is also because, world oil production and consumption are by and large concentrated in different parts of the world, relatively

[31] *supra* footnote 14, at pp.6-8
[32] *supra* footnote 30, at p.15
[33] *supra* footnote 30, at p.22.

far away from each other and separated by oceans. As a principle source of energy for industrial activities and daily consumption, oil is consumed to a large extent in the most industrialized parts of the world with high income per capital. For instance, in 2003, above 67 per cent of oil was consumed by the OECD countries, which contribute over 70% of world GDP.[34]

The main ocean shipping lines of crude oil are those from the Middle East to Northeast Europe, the Mediterranean Sea, North America, Japan and other Asian regions; from North Africa to the Mediterranean Sea; from West African to North America; and from Caribbean region to North America. The countries and regions with crude oil exports exceeding 100 million tons are the Middle East, North Africa, West Africa, Egypt, Venezuela and Mexico. The countries and region with crude oil imports exceeding 100 million tons are the United States, Western Europe, Japan and South Korea, China. The crude oil transportation lines situation in 2003 is outlined in Appendix A. Furthermore, the following Figure 2 highlights the major oil trade movement of the world in 2005.

Figure 2: World Major Oil Trade Movement in 2005



(Source: BP Statistical Review of World Energy 2005)

[34] *supra* footnote 30, at p. 23.

As oil trade always flows to economic production centres and there are new centres emerging in the developing world, the oil trade pattern described above will certainly be changing accordingly.[35]

According to the BP energy analysis, in future 15 years, the world petroleum supply and demand will keep the trend of stable growth. The world marine crude oil transportation volume is expected to continue to grow by an annual increase of 2.0% and will reach approximate 1.9 billion tons in 2010 and approximate 2.1 billion tons in 2015.[36] Table 1 shows the oil imports and exports situation of the three biggest economic entities in the world. These selected countries are the biggest economic states of the world, too.

Table 1: Oil Imports and Exports in 2005(Million tonnes)

Countries	Crude imports	Product imports	Crude Exports	Product Exports
US	500,7	166,0	1,9	52,2
Japan	210,4	47,8	-	5,1
China	127,1	39,8	6,7	14,0
Total World	1885,2	576,3	1885,2	576,3

(Source: retrieve from "BP Statistical Review of World Energy June 2006")

From the above table, it indicates that US imported about 500 million crude oil in 2005, which is bigger than the total of Japanese and Chinese imported crude oil. In addition, Japan relies entirely on crude oil imports as it doesn't export any crude oil. As for these three countries, they are the biggest crude oil importers of the world.

[35] *supra* footnote 30, at p.24.
[36] See BP energy analysis, in BP Statistical Review of World Energy June 2006, at http://www.bp.com/statisticalreview.

2.1.2 Tanker Fleet

Oil tanker fleet is the largest type fleet of the world, accounting for about 40% of the total tonnage of world commercial fleet. Tankers carry their cargo in a number of tanks or compartments within the hull of the ship. According to the size of the tanker, there are four classes of tankers: Aframax, Suezmax, VLCC and ULCC.

The demand of tanker fleet depends mainly on the oil transport market. As described above, the oil seaborne trade increased steady during recent decades, the capacity of tanker fleet increased accordingly. The situation is proved by the historical data of the Table 2.

Table 2: Development of World Tanker Fleet and Trade 1992-2004

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fleet[1]	225	227	231	223	227	229	232	237	236	244	235	245	258
Trade[2]	5.8	6.4	6.6	6.9	7.1	7.7	7.4	7.3	7.6	7.6	7.7	6.8	7.0

Note: 1.Million dwt at mid-year, Vessels over 50,000 dwt.

2.Cargo tonnes per dwt.

(Source: retrieved from *Fearnleys* Review 2005)

In the above Table 2, the world tanker fleet have been compiled and calculated additional figures like cargo tonnes per dwt in order to give the reader a better view of the developments during the last twelve-year period, particularly as to the efficiency of the fleet. The concept 'cargo tonnes per dwt' is not the true measure of efficiency, but this statistical result is an indicator of vessels' employment.

In the previous section, it mentioned that about 1,673m tons crude oil in 2003 was moved by sea. But this figure is not reflecting the exact size of the world oil seaborne trade needs. By knowing only the volume of oil seaborne trade, one cannot tell how many tankers are required for the transport because of the oil seaborne geography.[37] In a maritime transport sector such as tanker shipping, the distance that crude oil has to travel must be taken into consideration.

[37] *supra* footnote 30, at p.31.

Table 3: World Seaborne Trade on Crude Oil by Tankers 1992-2004

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Million tonnes	1313	1356	1403	1415	1466	1519	1535	1550	1608	1592	1588	1673	1800
Billion tonne-miles	6977	7251	7330	7224	7495	7830	7889	7980	8180	8074	7848	8390	8910

(Source: Compiled from *Fearnleys* Review 2003 & 2004,)

The Table 3 shows the situation of the billion tonne-miles as well as the crude oil million tonnes by tankers during the period from 1992 to 2004. Essentially, the distance is important to maritime transport and thereby the tonne-miles make more sense for tanker fleet.

2.1.3 Tanker Fleets of Selected Countries

According to ISL, by early 2003 the world national and regional oil tanker fleets were ranked as follows: Greek oil tanker fleet as number one with 64.4 million dwt; that of Japan was number two with 37.1 million dwt; that of US was number four with 29.1 million dwt; that of South Korea was number eight with 8.3 million dwt; and the fleet from Chinese mainland was ranked number twelve with 6.38 million dwt.[38] As of July 1, 2004, Table 4 indicates the biggest twelve tanker fleets by country of owner.

[38] See ISL, which is an Institute of shipping economics and logistics in Europe."*Shipping Statistics Year Book in 2004"*, the world fleet, shipbuilding and ports, etc. online available at http://www.isl.org/prodcuts_services/publications/ssmr.shtml.en

Table 4: Tanker Fleet by Country of Owner of Selected Countries

(Tonnage in Thousands)

No.	Countries	Number	DWT	No.	Countries	Number	DWT
1	Greece	857	71,079	7	Saudi Arabia	78	11,584
2	Japan	797	40,469	8	Germany	249	10,295
3	United States	371	28,390	9	China	327	9,216
4	Norway	393	25,658	10	Russia	422	9,083
5	Hongkong	154	14,505	11	United Kingdom	173	8,566
6	Singapore	324	14,487	12	India	125	8,335

(Source: ISL Shipping Statistics Year Book in 2004)

From the above Table 4, the average tanker size of US is bigger than in China by comparing the dwt at a similar amount of tanker numbers. In US, there is a sum of 28,390 thousands of dwt with 371 tankers. However, there are a total of 9,216 thousands of dwt with 327 tankers. This indicates the tanker size become bigger and bigger in recent market.

In order to reduce the operational cost and minimize risks, more and more ships would register with flags of convenience or flags of certain foreign countries. According to ISL statistics, up to 2003, 63.1% of the world commercial fleet tonnage was registered with flags of foreign countries, increased by 1.3% over that of 2000. Furthermore, among this, 62.4% of the world oil tanker fleet tonnage was registered with foreign flags, increased by 0.2% over that of 2000.

In terms of countries, Saudi Arabia had the largest proportion of 94.2% foreign flags in oil tanker fleets; Japanese oil tanker fleets had the second largest proportion of 81% foreign flags; the proportion of that of South Korean is 78.1%; and Chinese mainland had the smallest proportion of 38.1%.[39]

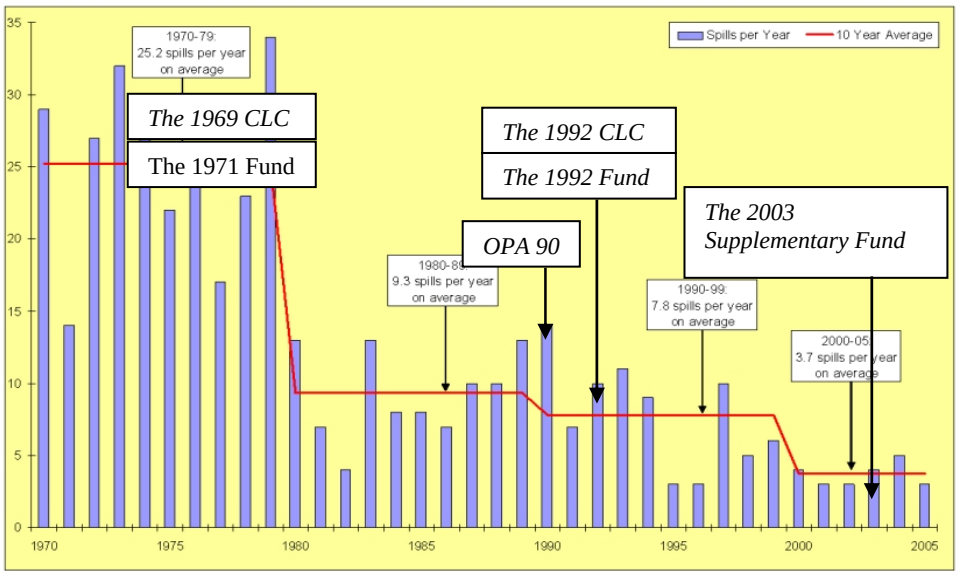
[39] *supra* footnote 37. As for the countries, see *supra* footnote 5, at pp66-67. It analyze that Japan's role in world shipping is significant in view of the size of its economy and the strength of its industrial production. Due to its lack of natural resources, Japan relies heavily on the imported in large volumes.

2.2 Oil Spills

2.2.1 Oil Spill Statistics

The majority oil spills come from the tanker accidents. According to ITOPF's worldwide oil spill statistics, accidents involving spillage of over 50 tonnes of oil took place in 112 countries during the past 40 years.[40]

Figure 3: Numbers of Oil Spills over 700 Tonnes



(Source: retrieve from ITOPF at http://www.itopf.com/data)

Figure 3 shows a dramatic reduction in the number of oil spills from tankers. For instance, from year 2000 to 2005, the average number of spills per year is about 3.7 in contrast with 9.3 spills per year on average during 1980 to 1989. However, there were about 25.2 spills per year on average during the first ten statistic years: 1970-1979. Therefore, the number of oil spill from tanker accidents has decreased a lot.

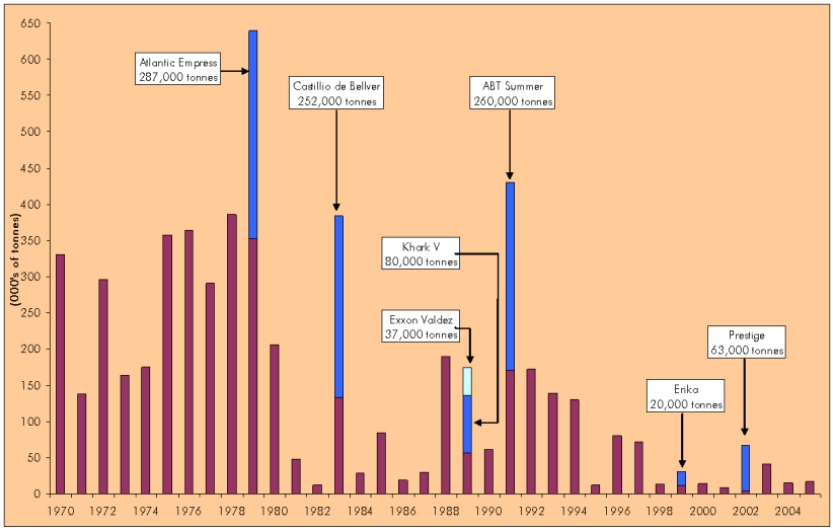
Furthermore, it is notable that a few very large spills are responsible for a high percentage of the oil spilt. For example, in the ten-year period 1990-1999 there were

[40] ITOPF is a source of comprehensive information on marine oil pollution through its library, wide range of technical publications, videos and website, at http://www.itopf.com/statistics .

358 spills over 7 tonnes, totally 1,140,000 tonnes, but 830,000 tonnes (73%) were spilt in just 10 incidents (just under 3% of the total number of accidents).

Moreover, the figures for a particular year may therefore be severely distorted by a single large incident. This is clearly illustrated by 1979 ("*Atlantic Empress"* – 287,000 tonnes), 1983 ("*Castillo de Bellver"* – 252,000 tonnes) and 1991 ("*ABT Summer"* – 260,000 tonnes). Since 1967, the biggest size of oil spills was *Atlantic Empress,* which happened in 1979 off Tobago in West Indies, caused about 287,000 tonnes oil spill.[41] The amount of oil spill per year is illustrated in the following Figure 4.

Figure 4: Quantities of Oil Spill from 1970 to 2004



(Source: retrieve from the ITOPF at http://www.itopf.com/stats.html)

From the above graph, we could also conclude that the majority of oil spill came from the big tanker accidents in a particular year. Such as in 1999, the sinking of the oil tanker *Erika* off the French coast in December spilt about 20,000 tonnes crude oil in all. Most of these disasters require an entire investigation of the cause and consequence as well as the further influence on the regulation of tanker safety.

[41] *supra* footnote 37.

2.2.2 Casualty Analysis of Tankers

Most incidents are the result of a combination of actions and circumstance, all of which contribute in varying degrees to the final outcome.[42] Basically, there causes can be grouped into "operations" and "accidents". Generally, most spills from tankers result from routine operations such as loading, discharging and bunkering which normally occur in ports or at oil terminals – perhaps as many as 92% of oil spills.[43]However, the majority quantities of these operational oil spills are small, with some 91% involving quantities of less than 7 tonnes. The accidental causes such as collisions, groundings and non-accidental structural failures generally give rise to much larger spills, with at least 84% of incidents involving quantities in excess of 700 tonnes being attributed to such factors.[44]

The European Commission provided funding for a 3-year project entitled "*Pollution Prevention and Control – Safe Transportation of Hazardous Goods by Tankers*" (POP&C), which starting in 2004 aims to develop a framework and first-principles tools for a methodological assessment of risk.[45] The project selected the AFRAMAX class of tankers to do the data analysis. The selection of the particular tanker ship size was based on DWT size segment 80,000 – 119,999.

Therefore, in the following section, all the analysis and conclusions are limited to the selected class of tankers: AFRAMAX.

2.2.3 AFRAMAX Case

The Aframax class of tanker is the most populous class of internationally trading large oil tankers. As for the relatively large market segment of the AFRAMAX tankers, past spectacular catastrophic tanker accidents involving AFRAMAX tankers and relatively high number of single hull AFRAMAX tanker, which are currently

[42] See Dr. Jens-Uwe Schroeder, "*Casualty Investigation*", unpublished handout at the World Maritime University, Malmö, Sweden.
[43] *supra* footnote 1.
[44] *supra* footnote 37.
[45] *supra* footnote 16, at p.14.

operational and expected to continue operating until they reach the recently amended (accelerated) phase-out date.[46] Since the POP&C project has used the AFRAPMAX size tankes to demonstrate the applicability of the developed risk based methodology, the analysis of past incidents was also focused on records pertaining to AFRAMAX tankers.

2.2.3.1 Data Collection

The historic data from the period 1978 to early 2004 was derived from Lloyd's Marine Information Service and from Lloyds' Register-Fairplay. Out of all the available records, 1294 incident records were finally extracted. Six casualty categories were identified as the key hazards leading to loss of watertight integrity, namely: collision, contact, grounding, non-accidental structural failure, fire and explosion. The oil spill comes out if the ship's watertight integrity were lost. Operational pollution and pollution resulting from failures of hull fittings were left outside the scope of the project. The whole data and methodology were illustrated in the research of POP&C project.[47] In this section, only the oil spill accidents are retrieved to emphasize the scope of the research.

2.2.3.2 Accident Rates per year

Taking into account the accidents that led to serious and catastrophic (total loss) consequences (S-TL), the frequencies exhibit similar downward trends for all the accident categories investigated. In Table 5, the average values of rates are presented for pre and post-90 periods.

---

[46] See IMO news in 2003, "*Accelerate to phase-out the single hull tanker*", at http://www.imo.org .

[47] See Papanikolaou A, "*Systematic Analysis and Review of AFRAMAX Tankers incidents*", in the 11th International Association of the Mediterranean Congress IMAM, 2005. For the analysis of the relationship between the Incident Rates and Earnings, it concludes a trend of overall improvements in both earnings and safety. This is consistent with the generally held understanding that higher markets lead to higher incident rates. See *supra* footnote 16, at p.16.

Table 5: Accident Rates per year

Period	Accidents Rates	Rates of accidents with serious and catastrophic consequences
1978-1990	1.15E-01(1)	2.37E-02
1991-2003	3.81E-02	7.28E-03

Note: (1) E is an index number, which means $1.15*10^{-1}$

(Source: Papanikolaou A, 2006)

The Table 5 shows that in the post-90 period, not only the number of accidents was reduced but also the number of accidents with serious and catastrophic (total loss) consequences were reduced to almost the same extent. The reason of the significant improvement in the safety record of the AFRAMAX tankers may be considered to be the result of stricter international regulations enacted in the early 1990s and advances made in design and safe operation of tankers. A series of IMO conventions concerning the prevention of incidents and accidents have apparently contributed to this improvement.[48]

2.2.3.3 Spilled Tonne Rates per year

Taking into account accidents that caused environmental pollution, independently from the quantity of oil spilt, it is evident that the rate of accidents leading to pollution also decline during the studied period, but not to the same extent as in the case of all accidents.[49]

When the oil spill quantity is taken into consideration in calculating the rates per ship year, the result is somewhat different as described in the following Table 6.

[48] See *supra* footnote 16, at p.15.
[49] See Papanikolaou A., Mikelis N.,"*Critical Review of AFRAMAX Tankers Incidents*", 3rd International Conference ENSUS, in 2005.

Table 6: Average Rates of Accidents & Spilled Tonne Rates

Period	Rates of accidents with oil pollution	Spilled Tonne Rate per ship year
1978-2003	5.54E-03	32.5
1978-1990	6.74E-03	29.6
1991-2003	4.35E-03	35.4

(Source: Papanikolaou A, 2006)

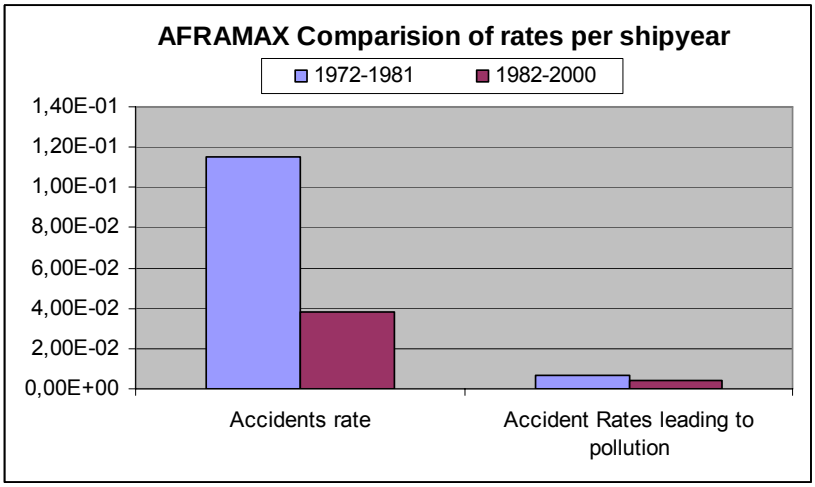
From the Table 6, although the frequency of accidents has been substantially reduced in the post-90 period, there is no reduction in spilled tonne rates in the same period, but even an increase.

The reason was that some particular casualty per year would cause serious environmental damage. For instance, during the high spilled tonne rates were experienced in the following three years: 1980, 1993 and 2002, this is not related to a high frequency of accidents resulting to pollution, but to one individual casualty per mentioned year with serious environmental consequences, namely "*IRENES SERENADE*" (80,000t spilled, 1980), "*BRAER*" (88,214t spilled, 1993) and "*PRESTIGE*" (77,000 t spilled, 2002), which are also proved by the Figure 4.

2.2.3.4 Investigation Results

Therefore, the risk consequence to the environment has been slightly increased even though the frequency of accidents has been significantly reduced. This situation can also be proved by the following Figure 5.

Figure 5: Comparison of Rate's Reduction



(Source: compiled from the POP&C project)

In conclusion, for AFRAMAX tankers, the accident rate per shipyear has reduced significantly when considering pre and post 1990 accidents. However, the rate of accidents leading to pollution per shipyear has reduced by a less significant amount. There is something that should be emphasized that the AFRAMAX tankers are only a part of all the tankers. The statistic analysis aims to discover the trend of accident rate and accident rate leading to pollution. The potential founding in this research is that the quantity of oil spilled accident mainly relies on the individual tanker casualty.

2.3 Tanker Accident Impact on the Conventions

Although the tanker appears by statistics to be safer than before, marine incidents always happened and oil spill will continue to. The prime concern of tanker casualty statistic is not to totally eliminate the incidents/accidents, because the probability of occurrence always exists, but to minimise the probability of occurrence and to mitigate the serious consequences of an incident/accident.[50] Investigations into some tragic tanker and other ship accidents have provided an in-depth knowledge

[50] See *supra* footnote 39.

and experience to change the tanker safety regime in the past years. Significant outcomes of some catastrophic casualties that were investigated, led to improvements of IMO's regulatory framework and eventually of marine safety and operation.

As far as the Tanker Fleet is concerned, some serious casualties led to the adoption of new regulations or amendments of the existing ones.[51] Some spectacular tanker casualties are stated below:

- The grounding of "*Torrey Canyon*", in 1967, led to the biggest marine pollution in history at that time. The result of this investigation contributed to MARPOL 1973, STCW 1978 and SOLAS 1974 (fire safety provisions for tankers).
- The grounding of "*Argo Merchant*", in 1976, contributed to the development of Protocol 1978 of MARPOL.
- The grounding of "Amoco Cadiz", in 1978, led to the implementation of MARPOL 1978 Protocol.
- The "Exxon Valdez" casualty, in 1989, led to the adoption of the first regional agreement (application in US waters), OPA 90.
- The "Erika" disaster, in 1999, contributed to the revision of MARPOL 73/78 (Reg. 13G) which regulated a new phase-out for single hull tankers (MEPC-IMO). Furthermore, this particular accident led the European Union to the adoption of the ERIKA I and ERIKA II EU Marine Resolutions.
- Following the "Prestige" accident in 2002, the European Union adopted Regulation 1726/2003 (accelerated single hull tanker phase-out, carriage of heavy grade oils in double hull tankers, enhanced hull condition assessment). This regulation took effect within EU on 21 October 2003. The IMO's Marine Environment Protection Committee (MEPC) adopted amendments to Regulation 13G and produced Regulation 13H to Annex I of MARPOL on 4 December 2003.

[51] See Dr. P.K.Mukherjee, "*Law of Marine Pollution"* lectures (2006) at the World Maritime University, Malmö, Sweden.

As examined above, multilateral standard-setting on the tanker pollution regulations is conducted primarily within the IMO arena where the interests of the relevant actors are advanced and reconciled. Alan offers a comprehensive and convincing account of how ships may be better regulated and reduced by analysing the regulation of vessel-source pollution from the perspective of the political interests of key players in the ship transportation industry.[52]

2.4 Chapter Summary

Presently, crude oil seaborne trade remains as a key factor in the world seaborne trade with the development of world economics. As forecasted in future 15 years, the world crude oil supply and demand will keep the trend of stable growth. This explains why the need to maintain vigilance in oil pollution. Overall, the fact that increasing regulation has led to declining levels of tanker casualties. However, in terms of AFRAMAX tankers in last decades, the accidents rates has declined in contrast that the accidents lead to oil spill is relatively stable.

Above all, the potential tanker accidents will exist once the oil seaborne trade continues. The tanker safety is still a key issue among the shipping industry. Ultimately, the stakeholders in the oil seaborne trade should be made to assume a larger share of environmental liability and responsibility. In this regard, the following chapter will consider the civil liability and compensation on oil pollution damage.

[52] *supra* footnote 5, at pp.10-17

CHAPTER 3

3 Maritime Environment Regulations on Oil Pollution Damage

The legal framework of maritime environment is of primary importance in the oil compensation regime, and the relevant IMO conventions are most commonly applied in this area.

This chapter begins with a review of general legal framework of marine environment from public international law to private law, in particular, the development of the civil liability and compensation regime under CLC/FUND conventions. In following sections, a guide to the international conventions on liability and compensation for oil pollution damage is briefly reviewed, and specific features like ‘pollution damage’, ‘claims for environmental damage’ and ‘property rights’ are discussed.

3.1 The Legal Regimes Addressing Marine Pollution

The subject of marine pollution is of prime importance in today’s maritime world, in particular, to the quality shipping and environment friendship. Marine pollution concerns arose only after oil was discovered in the early part of this century, and oil tankers entered the arena of shipping and ocean transportation. The problems relating to pollution of the seas are on-going and the law appears to be continuously developing to cope with the consequences. At present, there is a whole body of law on the subject of tanker oil pollution governed largely by international conventions. The law stretches across a spectrum from public international law to international

private law. [53] Until recently, there were also international voluntary schemes which were contractual in nature.[54]

3.1.1 Public International Law Regime

The public international law framework for the regime of vessel source pollution is contained in Article 211 of UNCLOS, which requires flag states to adopt laws for the prevention, reduction and control of marine pollution applicable to their ships.[55] Moreover, UNCLOS provides a broad jurisdictional framework within which the regulation can be located. In essence, the laws must be consistent with generally accepted international rules and standards established through the relevant competent international organization or general diplomatic conference, such as IMO.

As far as IMO conventions are concerned, marine pollution related regulations can be divided into three categories: regulations of pollution prevention, regulations of response and reaction and regulations of liability and compensation.[56]

Firstly, regulations of pollution prevention include conventions of MARPOL 73/78, Dumping, Intervention, Anti-fouling (AFS) and Ballast water management (BWM). These sets are designed to prevent pollution of the marine environment. Prime among these is the International Convention for the Prevention of Pollution from Ships. For instance, MARPOL 73/78 Convention, which has six annexes, deals with oil pollution, pollution by chemicals carried in bulk, harmful substances in packaged form, sewage, garbage and air pollution. Others include Conventions on the dumping of wastes at sea, on the rights of coastal states to intervene if their

---

[53] *supra* footnote 18, at p.203. See the Law of Marine Pollution lectures at the World Maritime University. Besides the international conventions, there are also penal laws as well as civil liability regimes, both statutory and otherwise in domestic spheres, which fall outside the scope of international conventions. For instance, the Oil Pollution Act 1990 of the United States is a domestic statutory liability and compensation which has international implications.

[54] *supra* footnote 18. Tanker Owners Voluntary Agreement Concerning Liability for Oil Pollution (TOVALOP) and Contract Regarding a Supplement to Tanker Liability for Oil Pollution (CRISTAL). These schemes has now been terminated.

[55] See Article 211, "*Pollution from vessels"*, in UNCLOS.

[56] *supra* footnote 18, at p.204-205. In addition, Dr. P.K. Mukherjee also brings forward a principle to divide the Marine Pollution Conventions in to three areas: Public, Regulatory and Private, which are closely interfaced. See *Law of Marine Pollution* Handouts (2006) at the World Maritime University, Malmö, Sweden.

coastline is under threat of pollution following upon a maritime casualty, on the use of certain toxic substances in ships' anti-fouling paint and on ballast water management.

Secondly, the regulations of response and reaction cover SAR, OPRC with HNS protocol. In these series of Conventions have been developed that are designed to ensure a proper response to minimise the negative repercussions when accidents do happen. The most important consideration is the protection of human life, and to this end the International Convention on Maritime Search and Rescue (the SAR Convention) enshrines an international SAR plan to ensure that, no matter where an accident occurs, rescue operations will be co-ordinated by a proper search and rescue organization and, when necessary, by co-operation between neighbouring SAR organizations. Moreover, other measures in this category include the OPRC Convention which establishes measures for dealing with pollution incidents, either nationally or in co-operation with other countries, and its related protocol dealing with hazardous and noxious substances.

Lastly, to deal with the aftermath of casualties, IMO has developed a series of Conventions to cover questions of liability and establish compensation regimes for victims of pollution incidents and accidents. These include CLC, FUND, the Bunker Convention and the HNS Convention.[57]

All these Conventions are kept up to date, with limits of liability increased where appropriate to match changing demands and expectations. However, in terms of existing international law, the central deficiency relates to the means of financial accountability – liability – for environmental harm across national boundaries and to the global commons.[58]

---

[57] International Conventions on Civil Liability for Oil Pollution Damage, 1969 as amended by the Protocol of 1976; International Convention on the Establishment of an International Fund for Oil Pollution Damage, 1971. The 1984 Protocols to both these Conventions failed to go into force. New Protocols to the CLC and Fund Conventions have since been adopted in 1992 to revise the limitation regimes. Supplementary Fund Protocol, 2003.

[58] See Sandvik B, Suikkari S. "*Harm and reparation in international treaty regimes: an overview"*. In: Wetterstein P, editor. Harm to the environment: the right to compensation and the assessment of damage. Oxford: Clarendon Press, 1997. at p.58.

The following sections only concentrate on the civil liability regime for tanker oil pollution, which enables national victims of oil spill damage to make financial claims against domestic and non-domestic tanker owners and, in certain circumstances, the global oil cargo industry.

3.1.2 The Development of International Liability Regime

3.1.2.1 The Initial International Conventions

Prevention of tanker oil pollution has been an international regulatory goal since 1954, giving rise to various conventions, resolutions and codes developed under the auspices of IMO. It was not until 1954 that the UK arranged a conference which resulted in the adoption of the first international treaty to prevent oil pollution of the seas from ships.[59] However, it was the *Torrey Canyon* disaster that confirmed the oil pollution would have to be done at an international level, namely, through IMO. The sinking of the tanker *Torrey Canyon* on 17 March of 1967 spilt 120,000 tons of crude oil into the sea off the south-west coast of England. It provoked the forerunner of IMO- the International Governmental Maritime Consultative Organization (IMCO) – to review state systems of civil liability for oil pollution damage.

This initial regime consisted of the CLC 69 and FUND 71. The CLC placed the liability for oil pollution damage on the owner of the ship from which the polluting oil escaped or was discharged: The CLC generally adopted a standard of strict liability, though liability was limited to an amount that was approximately double the limits set under the 1957 International Convention Relating to the Limitation of the Liability of Owners of Sea-Going Ships. The intent here was to facilitate prompt, equitable compensation payments to victims for damage suffered in the territory, including the territorial sea, of any contracting state.[60] To aid this, ships carry more than 2,000 tons of persistent oil as cargo were required to maintain insurance with respect to oil pollution damage. Without insurance, the strict liability of shipowners would not be effectively enforced in cases in which the shipowners were financially unable to

[59] *supra* footnote 1.
[60] See .Mason M., *"Transnational environmental obligations: locating new spaces of accountability in a post-Westphalian global order"*. Transactions of the Institute of British Geographers 2001, (26), at pp.407-429.

satisfy the amount of damages. Claims could be brought in any state where the oil pollution damage was suffered.[61]

However, the CLC was criticized by both shipowners and victims. For the shipowners, the CLC was considered excessive in the conservation world of maritime law in 1969, in that replaced fault liability with strict liability and doubled liability limits.[62] The victims, on the other hand, feared that compensation might be inadequate for oil pollution damage from large tankers because the compensable amount would be decided by the capacity of the insurance market rather than by oil pollution damage or shipowner's act.[63]

The Fund Convention was hereby created to supplement insufficient compensation to victims in return for limiting liability of shipowners in order to readjust their burden.[64] Furthermore, Trew and Seward asserted that oil cargo interests should bear some of the economic consequences of oil pollution damage.[65] As part of the Brussels compromise, IMO was entrusted therefore with the creation of a new international fund to supplement the liability coverage of CLC 69: the Fund 71 sharing a strict liability and compensation ceiling framework, established a statutory system compelling oil cargo interests in contacting states to pay a levy, calculated on the basis of their national share of international oil receipts. In 1978, the IOPC Fund, built up from oil cargo owner contributions, was established to administer the compensation scheme under the Fund Convention. Thus, the two conventions as a whole came to provide a distribution of the financial burden between shipowners and oil cargo owners. The Fund Convention also included provisions for relieving shipowners of a percentage of their liability exceeded a specified amount. It should

---

[61] See Abecassis D. "*IMO and liability for oil pollution from ships: a retrospective*". In: Lloyd's Maritime and Commercial Law Quarterly 1983; at pp.46-52.
[62] See Jacobsson M. "The international conventions on liability, compensation for oil pollution damage and the activities of the international oil pollution compensation fund". In: Colin M. de la Rue, editor. Liability for damage to the marine environment. Lloyd's of London Press, 1993. at p. 39
[63] See Rha YS. "*A study on the compensation regime of oil pollution damage*". Unpublished Ph.D. dissertation, Hankuk University of Foreign Studies, 1992, at p.68. available online at http://www.sciencedirect.com
[64] See Berlingieri F. "The work of the commit maritime international: past, present, and future". Tulane Law Review 1983; (57), at pp.1260-4.
[65] Trew, J., Seward, R. "*The Britannia Guide to Oil Pollution Legislation*". Britannia Steam Ship Insurance Association Ltd., London.

beard in mind that Parties to the CLC were not obliged to become parties to the FUND Convention. Up to 31 December 2000, the Fund 71 had approved the statement of pollution damage claims arising out of 96 incidents, amounting to over £263 million in total compensation payments.[66]

3.1.2.2 The 1984 Protocols

The formulation of the international liability and fund schemes hinges on compromises among economic and political interests to solve the deadlock on the basis issues of the responsible party and the nature of the liability.[67] For instance, CLC 69 contracting states with sizable tanker interests (e.g. Greece, Korea, Liberia) were expressing alarm at incidences of national courts breaking shipowner rights to limited liability under the convention, undermining in their view both the economic viability of their shipping industries and the much vaunted equity of application of CLC 69.[68]

After the 1978 *Amoco Cadiz* disaster, it was recognized that the liability limits of the two conventions were too low to provide adequate compensation in the event of a major oil spill. Continuing inflation had led to a substantial erosion of the liability limits, providing insufficient compensation for damages caused in a major incident. Two conventions increase the share of the burden on the oil cargo owner, decreasing that of the shipowner as a result both of inflation and of frequent oil spills whose damages exceeded the shipowner's liability limit. Another favourable factor for change was the expansion in the capacity of the P&I Clubs' market since the adoption of the two conventions. For the purpose of revising the two conventions, the IMO legal committee convened in 1983. The IMO committee examined liability limits on shipowners and revisited the issue of allocating the burden of compensation for oil spill damages between the shipowner and oil cargo owner. When applying the liability limits under the CLC and the 1984 Protocol to approximately 1700 oil spills covering 1970-1982, the share of total oil pollution

[66] See IOPC Fund Annual Report 2001, at pp.37 and 150-171, online available http://www.iopcfund.org
[67] *supra* footnote 27.
[68] *supra* note 5, at pp.313-314.

costs which would have been borne by the shipowner rose from 47% to 68%.[69] Shipowners opposed altering the existing balance between the shipowner and oil cargo based on considerably low freights.[70] From the shipowners' perspective, the burden on oil cargo owners could be alleviated by reducing the share of the contributions each faces, if more countries would ratify the existing Fund Convention. The IMO amended the two conventions by passing Protocols balancing numerous conflicting economic and political interests.

In an effort to induce the US participation, those Protocols broadened the scope of both geographical application and recoverable damages, and substantially raised the liability limits of the two conventions. However, because Japan, the largest contributor, and its oil industry felt that Japanese oil companies had carried a disproportionately large financial burden of contribution under the Fund Convention, Japan was reluctant to ratify the Protocol to the two conventions in the absence of an offer by the US to share the financial burden. Japanese oil receivers had paid contributions of £20 million in total while £5 million had been paid out in compensation for damages caused in Japanese territory for the first 12 years of the IOPC Fund. As a consequence, the Protocols failed to enter into force because of insufficient support from the countries and in particular from the US.[71]

3.1.2.3 The 1992 Conventions

In 1992, the IMO created new protocols to the two conventions that were identical to the 1984 Protocols except for the entry into force requirements. The main purpose of the new protocols was to facilitate the fulfilment of the requirements for the entry into force of the 1984 Protocols. This change was intended to make the conventions effective without the participation of the US. Japan wanted to cap a limit of the share of contributions payable by a single member state because it felt that its oil industry had borne an excessively large share of the total contributions levied under the

[69] See Jacobsson M. "*The international conventions on liability, compensation for oil pollution damage and the activities of the international oil pollution compensation fund*". In: Colin M. de la Rue, editor. Liability for damage to the marine environment. Lloyd's of London Press, 1993. at pp.39-55
[70] *supra* footnote 57.
[71] *supra* footnote 7, at p.147.

previous IOPC Fund. Because Japan had been the largest contributing member state to the Fund, the Japanese proposal to cap contributions was accepted over the opposition of many states. They feared the possible distortion of competition among the companies in member states because a cap by state would confer advantages on Japanese companies relative to those in other states. Italy, which was pushing for a greater recovery in the wake of the 1991 *Haven* spill,[72] desired a broader interpretation of pollution damage. The Italian proposal to expand the definition of pollution damage was rejected because Italy's participation was less critical to the international regime, in particular taking into account the expanded liability under Italian proposal. The fundamental two-tier structure of the international regime remains untouched. The 1992 CLC seeks to provide uniform international rules and procedures for determining questions of liability and to provide primary compensation for pollution damage. On the other hand, the 1992 Fund Convention seeks to ensure supplementary compensation for pollution damage to the extent that the compensation provided under the 1992 CLC is insufficient.[73]

3.1.2.4 The 2003 Supplementary Fund

In October 2000, in the wake of the Erika accident off France, the limits of both the 1992 CLC and 1992 Fund Convention was increased by 50.37 per cent, in accordance with provisions contained in the Conventions.[74] There higher limits came into effect in all States party to one or both Conventions on 1 November 2003. A further important development occurred in May 2003 when a Protocol was adopted at the IMO creating 'The International Supplementary Fund for Compensation for oil Pollution Damage, 2003' ('Supplementary Fund'). This new 'third tier' Fund, which is closely modelled on the 1992 Fund, is designed to address the concerns of those States which consider that even the enhanced 1992 CLC and Fund limits might still be insufficient to meet in full all valid claims arising out of a major tanker accident. Ratification of the 2003 Protocol is optional but is available to any State that is party to the 1992 Fund Convention. All definitions on 'ship', 'person',

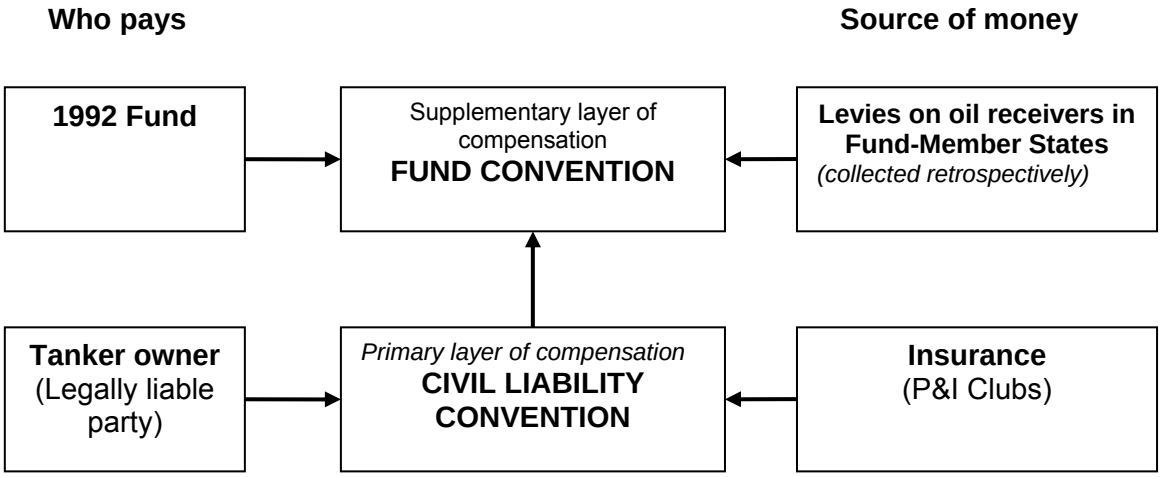
[72] On April 11, 1991, the *Haven*, a Crypriot tanker (109,977 grt) caught fire after having discharged a part cargo of Iranian crude in Genoa. The two parts of the vessel sank and oil leakage. The claims presented by the Italian aspects amounted to approximately Lit 1,541,488 million.
[73] *supra* footnote 27, at 268.
[74] See IOPC Fund Annual report 2004, at http://www.iopcfund.org .

'owner', 'oil', 'pollution damage', 'preventive measures' and 'incident' have the same meaning as in article I of the 1992 CLC and Article I of the 1992 FUND.[75] This implies that the 2003 Protocol does not change the meaning of the notion 'pollution damage', so that compensation for environmental damage is to be restricted to the costs of reasonable measures of reinstatement actually undertaken or to be undertaken.[76]

3.1.2.5 A Guide to the International Conventions

The two-tier system of compensation established by the international conventions: the owner of the tanker that causes the spill is legally liable for the payment of compensation under the first tier; oil receivers in Fund-Member States contribute to the second tier once the tanker owner's applicable limit of liability has been exceeded. The following Figure 6 describes the basic process of who pays the compensation to victims.

Figure 6: The Monetary Process of CLC/FUND



(Source: retrieve from http://www.itopf.com)

[75] "Pollution damage" is defined in the 1992 Convention as loss or damage caused by contamination. The costs of reasonable preventive measures (which include clean-up) also fall under this definition, as does any further loss or damage caused by preventive measures. The term 'persistent oil' is not precisely defined in the 1992 Conventions but, as a guide, it can be taken to include crude oil, heavy and medium fuel oil, heavy diesel oil and lubricating oil.

[76] See Dr. Guaci, G.M, Law of Marine Pollution lectures at the World Maritime University, at Malmö, Sweden.

As discussed above, shipowners are normally entitled to limit their liability to an amount that is linked to the size of the ship involved in an incident. The aggregate amount of compensation payable by the Supplementary Fund in respect of any one incident is limited to 750 million unites of account. The limits of liability in the Convention are actually expressed in Special Drawing Rights (SDR), which is a currency created by the International Monetary Fund (IMF). The value of the Convention limits in a national currency will therefore very depending on the exchange rate at the particular time. For instance, an approximate US dollar equivalent is given based on '1 SDR = US$1.4'. Then, the approximate maximum amounts of compensation available with regard to various sizes of tanker are illustrated in the Table 7.

Table 7: The Various Amounts of Compensation

Approximate maximum amounts of compensation available for various sizes of tanker (US$ million)		
Gross tonnage	1992 CLC	1992 Fund
5,000	6	284
25,000	24	284
50,000	40	284
100,000	84	284
140,000	126	284

(Source: retrieve from the IOPC Fund Annual 2004.)

In addition, CLC Convention lay down the principle of strict liability of shipowners through a system of compulsory liability insurance, which entitles victims of pollution damage to claim compensation directly from the shipowner's insurer.

In conclusion, the present international regime of compensation for pollution damage resulting from a spill of persistent oil from a tanker is based on CLC/FUND conventions.

3.2 Scope of Compensation for Environmental Damage

The 1992 Conventions cover compensation for five areas: costs of clean-up, including preventive measures; property damage; consequential economic loss; pure economic loss; costs of reinstatement of the environment and post-spill studies.[77] However, the main argument question among compensation regime is the admissibility of environmental damage claims within the scope of the CLC/FUND conventions. This section concentrates on the development of the IOPC Fund's policy with regard to environmental damage over the past 25 years.

3.2.1 Initial Quantification of Environmental Damage

The CLC 1969 defines pollution damage as 'loss or damage caused outside the ship carrying oil by contamination resulting from the escape or discharge of oil from the ship, wherever, such escape or discharge may occur, and includes the cost of preventive measures and further loss of damage caused by preventive measures.' While it was clear from the beginning that this wording covered economic losses connected with personal injury or property damage, the absence of any reference to environmental damage left this aspect to the interpretation of national courts according to the domestic implementation of the convention.[78]

The *Antonio Gramsci* incident, which grounding off Ventspils, USSR in 1979, was the first incident involving the 1971 Fund, which gave rise to the question of admissibility of claims for compensation for damage to the marine environment.[79] A claim of an abstract nature for ecological damage was made by the USSR against the shipowner and the amount claimed had been calculated on the basis of a mathematical formula laid down in USSR legislation.[80] In the light of this claim, the 1971 Fund Assembly unanimously adopted in 1980 a Resolution stating that *'the assessment of compensation to be paid by the FUND is not to be made on the basis*

[77] See *Claims Manual*, IOPC Fund 1992, April 2005 Edition, at pp.10-11.
[78] See Wetterstein, P., "*Harm to the Environment: The Right to Compensation and the Assessment of Damages*", Clarendon Press, Oxford, 1997, at p.234.
[79] IOPC Fund Annual Report 1988, at 62.
[80] USSR stands for "a former communist country in eastern Europe and Northern Asia, established in 1922, included Russia and 14 other soviet socialist republics; officially dissolved 31 December 1991."

of an abstract quantification of damage calculated in accordance with theoretical models'.[81]. Following the adoption of this Resolution, the Working Group took the view that compensation could be granted only if a claimant had a legal right to claim under national law and had suffered 'quantifiable economic loss'.

The *Patmos* incident in 1985 and the *Haven* incident in 1991, both happened in Italy, also gave rise to claims for environmental damage. The Italian Court and the 1971 Fund had a number of different views on those claims. In March 1999 an agreement on a global solution of all outstanding issues relating to the *Haven* incident was concluded between the Italian State, the shipowner/insurer and the 1971 Fund.[82] Under this agreement, the parties undertook to withdraw all legal actions in the Italian courts. The courts were therefore not called upon to make a final decision on the admissibility of the claims for environmental damage. The amount subsequently paid by the 1971 Fund in compensation did not relate to environmental damage.

3.2.2 New Definition of Pollution Damage

The CLC1992 Convention covers "pollution damage", which is defined as:

> "*loss or damage caused outside the ship by contamination resulting from the escape or discharge of oil from the ship, wherever such escape or discharge may occur. However, compensation for impairment of [damage to] the environment other than loss of profit from such impairment is limited to costs of reasonable measures of reinstatement actually undertaken or to be undertaken...*"

In view of this more precise definition it was hoped that the difficulties encountered by the 1971 Fund in the above-mentioned incidents would not arise under the 1992 Conventions. A Working Group established in 1993 included in its mandate the development of criteria governing the admissibility of claims for environmental reinstatement measures for adoption by the 1971 and 1992 Fund Assemblies. The

[81] See IMO Resolution No.3 of the 1971 Fund, FUND/A/ES.1/13.
[82] *supra* footnote 67.

Working Group concluded that measures for reinstatement of the environment should fulfil the following criteria in order to be admissible for compensation:[83]

- the cost of the measures should be reasonable:
- the cost of the measures should not be disproportionate to the results achieved or the results which could reasonably be expected; and
- the measures should be appropriate and offer a reasonable prospect of success.

The Working Group stated that the test of reasonableness laid down in the CLC 1992 should be the same as that adopted in respect of preventive measures, i.e., that the measures should be reasonable from an objective point of view in the light of the information available when the specific measures were taken. The Working Group considered that it would normally be necessary to carry out an in-depth study before any measures of reinstatement were undertaken, and that the cost of such studies should qualify for compensation provided that they fulfilled the requirements generally applied by the Fund in this regard.

As for the definition of the environmental impairment amendment, states that domestically had to balance shipping, oil industry and environmental interests. For example, from states with prominent shipping interests, like Greece and Liberia, preoccupied ruling out the possibility of excessive environmental damage claims. In contrast, Australia pushed for a broader definition of pollution damage to encompass liability claims for ecological impairment and restoration. In addition, to heighten public concern about oil pollution, UK moves to strengthen transnational environmental liability for pollution damage, but strong maritime trade interests moderated its ecological protection agenda. However, the clause 'reasonable measure of environmental reinstatement' failed to prevent subsequent inter-state disputes as to the application of the oil pollution liability regime to ecological damage.[84]

[83] See IOPC Fund., *Claims Manual* 2005.
[84] See Michael, Mason. "*Transnational environmental obligation: locating new spaces of accountability in a post-Westphalian global order*". Transactions of the Institute of British Geographers 26 (4), at pp.407-429.

This statement of meaning on environmental impairment was shaped by experience with the IOPC Fund 1971 and was therefore designed to limit environmental claims against both shipowners under 1992 CLC and oil receivers under the 1992 Fund. National courts in states which had ratified the 1992 protocols would not coherently be able to find for environmental damage claims beyond loss of profit and reasonable measures of reinstatement; this would rule out, it was planned, claims for environmental damage per se.[85]

3.2.3 Further Consideration of the Admissibility of Claims for Environmental Damage

In April 2000, a Working Group established by the 1992 Fund Assembly to assess the adequacy of the international compensation system gave further consideration to the question of environmental damage. The Working Group suggested that the amount of compensation to be based on the conclusions of environmental impact studies conducted in accordance with procedures adopted by the 1992 Fund and to allow compensation to be calculated using theoretical models. However, these proposals were not accepted since it was considered that they went beyond the present definition of 'pollution damage' in the 1992 Conventions.

As regards reinstatement measures, the Working Group focused on the development of additional specific criteria, recognising that most major oil spills do not cause permanent damage to the marine environment due to its great potential for natural recovery. The aim of any reasonable measures of reinstatement should be to bring the damaged site back to the same ecological condition that would have existed had the oil spill not occurred, or at least as close to it as possible. Measures taken at some distance from, but still within the general vicinity of, the damaged area might be acceptable, so long as it could be demonstrated that they would enhance the recovery of the damaged components of the environment.

[85] *supra* footnote 7.

Joe Nichols concluded that [86]

> "*Although the international compensation scheme has tended to focus on the compensation of victims of the economic consequences of oil spills, the experiences over the last 25 years have shown that the Member States have been willing and able to adapt the international compensation to the needs of society, in particular as regards the impact of pollution on the environment. While there is probably little that can be done to extend the scope of compensation for environmental damage within the current legal framework…"*

Besides these limitations, in practise, the features of marine environment are still a challenge to the claim of environmental damage from an environmental point of view.

3.2.4 Special Features of Claims for Environmental Compensation

3.2.4.1 Damage to Marine Environment

Claims for environmental damage of the kind considered in this section differ from other claims arising from pollution in two principal ways: they are not concerned with compensating loss or damage suffered by and particular claimant, and they are not quantifiable in conventional pecuniary terms. Therefore, the object of such claims is to provide a redress for environmental damage which remains unremedied after clean-up operations have been completed, and uncompensated by payment of claims for the cost of such operations, or for loss of earnings or other financial losses incurred as a result of the pollution. Typical claims of this type are those relating, for example, to fish or seabird mortalities. The basis for such claims lies in the value which natural resources are regarded as having to society, over and above their capacity to provide a livelihood for those who are financially dependent upon them.

[86] See Nichols, J., "*Chapter 4 Scope of compensation for environmental damage under the 1992 civil liability convention and the 1992 Fund convention*", in Maes, F., Marine Resource Damage Assessment: Liability and Compensation for Environmental Damage. Published by Springer, 2005, at pp.59-66.

Such claims often involve difficulty or controversy in ascertaining the true nature and extent of any damage attributable to pollution, particularly when account is taken of factors such as other causes of fluctuation in plant and animal populations, and the scope for recovery from the effects of pollution to be brought about by natural processes. They also involve problems in placing a financial value upon such damage for the purposes of assessing compensation. A further issue is the question of legal standing to bring such claims, and the question whether the state or any other public authority has the power to do so in a representative capacity.[87]

The growth of public interest in environment affairs since the *Torrey Canyon* incident in 1967, and the further impetus it gained after the *Exxon Valdez* incident in 1989, has led to increasing attention being paid to the possibility of redressing such claims by abstract methods of quantification or theoretical models. However, the difficulties and controversies surrounding these methods have thus far made them unacceptable to most member states of the IMO and IOPC Funds.

3.2.4.2 Technical Considerations of Damage to Marine Environment

It will be clear that technical considerations play an important role in assessing what damage, if any, pollution has caused to natural resources, and in evaluating the merits of any restoration programmer. This role is not simply one of quantification or evidence but merges with issues of legal principle: as explained earlier, the very notion of 'damage' – routinely used and understood in relation to property of static physical and chemical composition – can seriously mislead when applied to biological communities which are in a state of constant flux.

Furthermore, it is very difficult to conduct valuation of environmental damage. In most countries, the absence of any proprietary interest in the marine environment would be an insuperable obstacle to a claim of this nature. Where damage is caused to property which is subject to rights of ownership there is precedent for damages being based on diminution in market value, assuming that this can be established. Such an assessment is likely to be impossible where the claims is for damage to

[87] *supra* footnote 92, at 64.

natural resources in which there are no proprietary rights, which cannot be bought or sold, and for which there is accordingly no ascertainable market value.[88]

The main alternative to diminution in market value is the assessment of reinstatement costs. If the claimant actually carries out measures of reinstatement then the cost incurred provides a ready measure of damages, subject to considerations of reasonableness. Where the claimant does not carry out reinstatement or repair, and does not intend to do so, there is precedent for awarding the estimated cost of repair in certain cases. However, the rationale for this approach is that the cost of repair constitutes prima facie evidence of the loss in market value. This presumption is readily rebutted in cases involving damage to real property, where relatively large discrepancies have often been noted between costs of reinstatement and diminution in value. Furthermore, whilst it is one thing for the principle to be used I appropriate cases as a guide to the amount of a market loss, there are obvious objections to its use as a substitute for such a loss when it is plain that none has been suffered.

Accordingly, although claims have sometimes been made for damage to natural resources based on the theoretical cost of reinstatement, laws governing damage to property do not generally support such claims. For example, in US, claims for damage to natural resources have sometimes been made on the basis of theoretical formulae prescribed by national legislation, or been entertained by courts when supported by expert evidence. However, it is in the US that the most far-reaching attempts have been made to assess and redress such claims through intricate methods prescribed by NRDA regulations. These regulations seek among other things to quantify both ‘use’ and ‘non-use’ values. The former are concerned with the loss of amenity suffered by those who do not depend on the environment for their earnings, but who use it for other reasons such as leisure activities. ‘Non-use’ values, of ‘option’, ‘existence’ and ‘bequest’, address a broader interest in the environment of society in general. A well-known method of ascertaining these values is Contingent Valuation Methodology (CVM), involving assessments based

[88] *supra* footnote 13, at p87.

on responses to public surveys. This process is highly controversial but its use has been sanctioned by the US regulations.[89]

3.2.4.3 Policy Considerations of Damage to Marine Environment

Policy considerations enter the legal process when a decision whether to compensate claims for damage to natural resources takes into account the desirability, practicality, or implications of so doing. As considerations of this sort have often played a large part in such decisions, a brief review of them is given here.

Supporters of the approach taken in the US argue that difficulties in quantifying a loss do not signify that it has not been suffered, or that it does not merit redress, or that there cannot be a valid monetary claim once a financial value has been placed on the loss. In most countries the courts have found ways of compensating other forms of non-pecuniary loss, such as loss of physical amenity resulting from personal injuries, and associated pain and suffering. It is also argued that although no private proprietary interest may have been damaged; a public loss has been suffered for which compensation should be paid to a public trustee.

In all, there are a number of objections from various aspects:

- To preserve natural resources, it has been driven too frequently and too powerfully by media-led emotion and outrage, rather than by a realistic technical and scientific appraisal of the relevant facts.
- Awards made for damage to natural resources do not contribute to the restoration of the affected environment but constitute financial windfalls to public treasuries.
- Such awards is to exact retribution for public anger, and they are therefore essentially of a punitive rather than compensatory character.
- There is a substantial body of expert opinion which rejects CVM as excessively abstract and unreliable. In particular, assessments of damage may be seriously inflated if they are based on response which

[89] *supra* footnote 7, at pp.126-135. Dr. Gauci discussed the 'Monetisation of damage in environmental injury cases', which pointed that the difficulties in assessing damage to the environment were the meaning of value and the methodology to count. In addition, 'damage to natural resources' in commonly used in US, while it has the similar meaning with the 'marine environment' in this area.

are likely to be subjective and emotive, rather than upon an objective appraisal of the relevant factors by technical experts.

- The finite nature of the funds available to pay for pollution, and the adverse implications to be expected from overburdening compensation systems with large-scale damages for esoteric claims assessed by theoretical methods.
- The prospect that awards of this nature may result in the aggregate of claims exceeding liability limits, with the result that scaling-down of compensation causes unnecessary hardship to the real victims of the incident with indisputable claims; and
- The prospect that a highly effective compensation system founded on international agreement may disintegrated if it results in industries in member states being burdened with claims to a greater extent than their governments are willing to allow, or if it leads to irreconcilable differences between states whose laws allow such claims and those whose industries pay the greatest contributions towards the funds required to pay them.

Factors such as these explanations for the fact that member states of the IOPC Funds have on a number of occasions resolved overwhelmingly to reject claims under the Civil Liability and Fund Conventions when these are assessed by abstract methods or theoretical models, and to restrict claims for damage to the environment to the costs of reasonable measures of reinstatement actually undertaken or to be undertaken.[90]

3.3 Property Right and Externality

3.3.1 The State as Environmental Trustee

The *Patmos* case highlighted the possibility of a state's right to environmental compensation as trustee of collective interests; that is, as representative of its affected public as a national community.

[90] *supra* footnote 92, at p66.

In that case the Italian courts stated that CLC 1969 made no distinction between private property damages and public property damages: they found, moreover, that direct public ownership was not necessary to justify environmental compensation claims because the state as a trustee for national or publics has a right of action beyond economic loss.[91] However, the IOPC Fund has recognized that public bodies can be legitimate claimants under the oil pollution liability regime; it has not accepted trusteeship claims divorced from quantifiable elements of economic damage. In the *Haven* case the Fund Executive Committee observed a punitive element in the environmental damage claims neither admissible under the civil liability rules nor of any consequence to the shipowner.[92]

3.3.1.1 Current Situation

More recently, the right of a state as public trustee to claim environmental compensation has been championed by the French government – within an IOPC Fund 1992 Working Group reviewing the international oil pollution liability conventions. After *Erika* incident, French moves to liberalize the environmental reinstatement rules of the international oil pollution regime conjoined the state trusteeship principle with a broader notion of compensation. They argued, If this was only implicit in Article 235(3) of the LOS Convention requiring states to assure 'prompt and adequate compensation in respect of all damage caused by pollution of the marine environment '[93], then it was certainly clear in constitutional and legal obligations embraced by many countries.

In the wake of the *Erika* incident, the European Commission published its own proposals for European maritime safety. One of its key recommendations called for CLC1992 to be amended to enable restorative compensation for damage to the environment in a manner consistent with wider Commission proposals on civil liability for environmental damage.[94]

---

[91] *supra* footnote 7, at p.254.
[92] *supra* footnote 79.
[93] See UNCLOS 1982, at p1315.
[94] See Wilde, M.L.,"*The EC Commission's White Paper on environmental liability: issues and implications*". Journal of Environmental Law, 2001. 13(1), at pp.21-37.

3.3.1.2 Directive 2004/35/EC

In April 2004, the European Parliament and the Council adopted Directive 2004/35/EC on environmental liability within regard to the prevention and remedying of environmental damage.[95] The Directive covers damage to natural resources regardless the legal status of the natural resources. No distinction is made between owned or un-owned natural resources once the natural resources impacted are covered by this Directive. According to Article 6 of the directive, public authorities have the right to require the operator who caused a significant damage to the natural resources covered to take the necessary restoration measures.

First of all, the position of public interest groups has changed fundamentally compared to the Commission's White Paper on Environmental Liability (COM 2000). Unlike the White Paper, NGOs are now excluded from the right to claim compensation from alleged polluters. Instead, qualified NGOs are afforded the right to request the competent authorities that action be taken against a polluters. The public interest groups have the right to bring legal proceedings for review of the public authorities' response to their requests for action. Apart from the right to request the competent authority to take action and the right to start review procedures, public interests groups have the right to submit observations regarding the restoration measures to taken. Besides that, Gauci argued that the oil pollution liability conventions were not designed to provide full compensation for environmental damage.[96]

As for the property owners, it is the owner who has the right to sue if the pollution damage is caused to natural resources that are subject to property rights. Under this case, the public authorities are empowered to require polluters to take appropriate restoration measures or to take the measures themselves and recover the costs even if the natural resources concerned are owned. Property owners have not been awarded direct access to justice. In stead, they have the right under the Directive to

[95] Directive 2004/35/EC, OJL 143/56, 21 April 2004. Member States have until the end of April 2007 to transpose this Directive into domestic law.
[96] *supra* footnote 8, at p.32.

request the public authorities that action be taken against a polluter, provided they suffer environmental damage.[97]

3.3.2 Externalities

3.3.2.1 Cause of Externalities

The public-goods nature of environment reveals another important feature: externalities. An externality is said to exist when an activity by one agent causes a loss of welfare to another agent.[98] For example, a ship disposes oil into the water incurring financial or recreational losses to other people who have no economic relationship with the polluter. One reason for which externalities occur is the failure of the market to price the effects caused by one person with such a failure leaving the affected person un-compensated. Therefore, the oil spill pollution at sea is negative externalities in this sense.[99]

The problem is that the property rights of environment goods are in most cases not identifiable. Another problem is the use of market price to measure the value and change of environment, despite the fact that many environment phenomena, problems and solutions are not sold and bought in a market and therefore can not be priced accurately. For example, in the *Exxon* disaster, Scientific American magazine noted at the time:" The public wants the animals saved – at $80,000 per otter and $10,000 per eagle……". It was estimated the casualty caused the deaths of 300 harbour seals, 2,800 sea otters, 250,000 sea birds, 250 bald eagles and perhaps 22 killer whales.

In all, one of the cornerstones of the market economy is the clearly defined property rights, which are exclusive, transferable and protected. In the absence of such property rights, markets will fail.[100]

---

[97] See Edward, H.P. Brans, "*Chapter 1 Estimating damages under the 2004 EC directive on environmental liability"*. in Maes, F., Marine Resource Damage Assessment: Liability and Compensation for Environmental Damage. Published by Springer, 2005, at pp.1-24.
[98] *supra* footnote 11.
[99] *supra* footnote 13, at p 80.
[100] See, Shuo, M., *Maritime Economics* lectures at the World Maritime Univesity in 2005, at Malmö, Sweden. This principle could also be seen in other economic writings. Such as, Hussein, M.A. *Principles of Environmental Economics*. London. (2004).

3.3.2.2 Solution to Externalities

Due to the conflict nature of the economic system and environment system, right choices need to be made to allow the overall long-term surplus for a society to be maximized. The economics of environment is for the purpose to study how these two conflicting systems interact and how the scarce resources can be allocated to balance the objectives of the two systems for the maximum benefits of the society. However, due to the special characteristics of environment problems markets fail to find solutions and ensure an efficient allocation of resources. Different economic approaches have to be developed to tackle the particular issues, especially those in relation to the lack of property rights and the existence of negative externalities. As a result of these special features, the total costs of production are not totally paid by the producers. Meanwhile, environment suffers. The efficient allocation of resources cannot be left to the markets. Three main approaches have been suggested to deal with externality problems.[101]

The first is the market solution. This approach allows free market systems to solve the problems through bargaining between those who create the externality and those who suffer from it. The advantage of this method is in its minimum requirement for government intervention. However, the major shortcomings are that the key assumptions, such as zero transaction cost, perfect competition, and no income effects are quasi-absent in the real world. So the method has little practical value.[102]

The second approach is to rely on self-discipline. Take maritime environment for example. It has been suggested that up-grading preventing pollution is a question of having the right mentality. Shipowners should be honest and improve environment until it is no longer economically feasible. This is certainly the noblest approach; the major advantage being its simplicity and low cost. However, it is not a proven

[101] See John Asafu-Adjaye. "*Environmental Economics for Non-Economists"*. World Scientific Publishing Co.Pte.Ltd (2000).
[102] *supra* footnote 98, at pp84-92. From the perspective of economics of law, Dr. Xu also mentioned this point in her lecture on "Economics of Marine Pollution" at the World Maritime University, in 2006, at Malmö, Sweden.

method and early experience has shown it to be either not effective or not sustainable. This is due to the fact that it depends so much on the social and cultural environment, which, in shipping, a highly open and global sector, is greatly diversified.[103]

The third method is by means of government intervention through rules and regulations. The advantage of this approach is the applicability: it is feasible and a proven method. The main deficiencies of the approach are the accuracy of the regulations resulting from subjective judgement, bureaucracy and political influence. A major goal of economics of environment is, therefore, to study various aspects of government regulations with the aim to enhance accuracy and effectiveness.

Therefore, only the third method is introduced to discuss the liability options on the oil pollution regime in the following chapters.

3.4 Chapter Summary

The civil liability regime for marine oil pollution was the first international liability regime to broaden compensation obligations beyond personal injury and property damage provisions to environmental impairment.

The liability and compensation laws in most states, be these founded upon international treaties or unilateral prescriptions, have typically replaced the traditional fault-based liability system with a regime of strict, non-fault liability on the part of the shipowner based on the principle of 'polluter pays'. It is the compulsory insurance for pollution damage up to the relevant limitation level under CLC, which enable the victims to take direct actions against insurers. The cargo owners bear only a secondary liability which arises if and when the shipowner's primary liability is unavailable or inadequate to compensate victims.

Currently, the damage for environmental compensation in the international regime is relatively limited because of the definition of 'pollution damage'. In practice, the

[103] *supra* footnote 97.

externality and property rights of environmental damage are special features to deal with the claims for environmental compensation. Besides these, there are some technical and policy consideration to deal with the scope for environmental compensation in the international regime. In the following chapters, the policy consideration on the liability options is therefore discussed.

CHAPTER 4

4 Economics of Maritime Environment Regulations on Oil Pollution

There is increasing law and economic study on environmental pollution embracing not only the issues of externality and property rights, but also the economic implications of liability regimes. They are all the foundation of this research.

In this chapter, the general principle of economics of environment is introduced, which confirms that maritime environment is an economic issue. The following section discusses the theoretical framework of economic analysis of maritime environment on oil pollution. Besides these, the theoretical model for oil import is introduced to show the elasticities of oil supply and demand in one state, which is key factor to affect liability policy. Finally, the concept of WTA is analyzed based on the statistic data of CLC/FUND states' income level.

4.1 An Overview of the Economics of Maritime Environment

4.1.1 The General Principle of Economics of Environment

The natural environment serves the human economy in three distinct ways: a source for both renewable and non-renewable extractive resources, a provider of environmental amenities and ecosystems services and a decomposer and a place of storage for various types of waster generated by normal economic activities. In addition, the natural environment can be used to assimilate or store industrial waste. To achieve the proper management of the environment, two considerations should be met. One is to understand the relationship between the increased economic

activity and the waste-absorptive capacity of the environment. The other one is to identify the trade-off between economic goods and environment quality at the margin. In other words, it is to identify the costs and the benefits resulting from the incremental use of the natural environment as a repository for industrial and municipal wastes.[104]

From the economic point of view, there are microeconomic and macroeconomic vantage points to study the trade-off between the production of goods and services and environment quality.[105] The microeconomic aspects of the issue deal with the development of the general theoretical condition for securing the optimal environmental quality. However, the macroeconomic one focuses on assessing the costs of ascertaining the desired environmental quality in terms of unemployment and inflation. As for the maritime transport, we take the microeconomic aspects as this research scope.

It may seem odd to carry out an economic analysis on environment protection issues, as all human economic activity obtains its energy and material from either the global ecosystem or the solar ecosystem and economic activity is, by nature, human intervention in the natural environment.[106] As long as we are engaged in transforming material inputs into economic goods, we cannot avoid creating residuals. These residuals of the economic process are commonly referred to as pollution. Then, pollution is an inevitable byproduct of economic activities. Therefore, ecology and economies are two conflicting systems.

Furthermore, by the first law of matter and energy, this residual has to go somewhere which comprises the various media of the natural environment – air, water and landscape. It is in this way that the natural environment is used as a repository for wastes generated through the economic process. The self-degrading ability of the natural environment is commonly referred to as its assimilative capacity.

---

[104] See Hussen A. "Principles of Environmental Economics (2nd Edition)", London, 2004. at p.45.
[105] See Shuo, M., "*Economics of Ocean Environment Management – Optimal Pollution Level and Environmental Regulations*", IAME Conference, MIT 1995.
[106] See Shuo, M. Maritime Economics, Unpublished handouts at the World Maritime University, at Malmö, Sweden, at p.126.

This assimilative capacity is limited, which depends on the flexibility of the ecosystem and the nature of the waste. Pearce pointed that pollution reduces the capacity of an environmental medium to withstand further pollution.[107] Furthermore, the obvious lesson in managing the natural environment is crucial to give careful consideration to the quality of the waste, its quantity and the rate at which it is disposed of into the environment. Mathematically, assuming at some predetermined level, there is a linear relationship between waste and economic activity.[108]

In particular, the relationship could be concluded as the following:

- The natural environment has a limited capacity to degrade waste, which means the waste assimilative capacity of the natural environment is a scare resource in pure physical terms.
- A certain minimum amount of economic goods can be produced without causing damage to the natural environment. Thus, zero pollution is not only a physical impossibility, but even on purely ecological considerations, it is an unnecessary goal to pursue.
- The cumulative effect of waste discharge into the natural environment is nonlinear although the simple model. This is because pollution tends to reduce the capacity of an environment to withstand further pollution.

In brief, the law of thermodynamics indicates that there can be no such thing as a non-polluting product and very few, if any, as non-polluting service.[109] To achieve zero pollution, we would have to have zero economic activity or reduce economic activities to a considerably low level, which are often illogical and not realistic.

4.1.2 Maritime Environment is an Economic Issue

Economics can be briefly defined as a study of choices among people's 'unlimited' wishes given 'limited' financial and natural resources. Clearly, such a definition implies the conflicting nature among various wishes or objectives. A general opinion

[107] See Pearce, D.W., & Turner, R.K. "*Economics of Natural Resources and the Environment*", London, UK, Harvester Wheatsheaf, at pp.35-42.
[108] *supra* footnote 101, at p47.
[109] *supra* footnote 103.

shows that occupational environmental issues cannot be separated from economic activities simple because the latter is the origin of the former.[110] Furthermore, Ma demonstrated that maritime safety and environment is an economic issue.[111]

Take maritime transport of oil as example, oil transport presents a danger of pollution to the ocean environment. Shipping is clearly responsible for a huge amount of oil pollution at sea. In terms of quantity, oil spill fell from 318,000 tonnes per annum in the 1970s to 110,000 tonnes in the 1990s. Yet only around 20% of the total derives from oil spills as such. A further 60% is the result of ballast water exchange. Natural oil seepage from the seabed accounts for 15% and oil platforms 2.5%, with the rest made up of other sources including industrial waste and run-off.[112] For instance, tanker accidents and tanker operation make up on average less than 10 per cent of the world total oil pollution into the sea, yet oil tanker ships have been considered by the public opinion as the major polluter of the sea. This is because tanker incidents may lead to the spill of large quantity of oil during relatively short period of time and within limited area, which will result in heavy losses before the polluting materials can finally be degraded by the environment. On the other hand, if the rate is appropriate, the discharge of oil from tanker ships into the open sea is believed to be of little harm and thus allowed.[113] Nevertheless, studies carried out by the United Stated National Academy of Science show clearly IMO has been in reducing pollution from ships – from over 2 million tons in 1973 to just over 500,000 tons in 1990, which attributes mainly on the statutory operation measures.[114]

As for the oil pollution regime is concerned, the environment is threatened by pollution coming from the oil tanker generated in an economic system. The economic system is certainly not alone in generating pollution, the natural system is certainly not alone in generating pollution, the natural system creates waste too, e.g. dead wood and leaves in a forest or waste from animals, but the natural system

[110] *supra* footnote 104.
[111] Prof. Shuo, M, *Maritime Economic* lectures at the World Maritime University, 2005, at Mamlö, Sweden. The content is also included in the reference *supra* footnote 103.
[112] *supra* footnote 13, at p85.
[113] Reg. 9of the Annex I in MARPOL 73/78 permits 15ppm oily water discharge rate.
[114] See Focus on IMO-MARPOL.

tends to recycle its waste. The economic system, however, has no such built-in tendency to recycle. The economic activities of man obtain the energy and materials needed from either the global ecosystem and an economic activity is, by nature, human intervention in the surrounding environment. The first law of thermodynamics implies that there can be no such thing as a pollution-free product and seldom, if at all, a non-polluting service. Ecology and economics can therefore be seen as two conflicting systems. Furthermore, Brown advocated that economy should be shaped by the principle of ecology rather than the market.[115]

Therefore, the environment questions fall within the sphere of economic analysis. The economic study of 'choices' is to define the objectives, to select the means and to measure the consequences and effects, which provides a set of principles and analytical tools to achieve the required balance.

As Xu stated that the current studies address the operational discharge or emissions from the penalty point of review.[116] However, the studies of liability and compensation regime, which are the key issues of accidental pollution, were not highlighted.

4.1.3 Special Features of the Economics of Maritime Environment on oil pollution

As discussed in previous sections, the problems associated with maritime environment on oil pollution cannot be completely tackled by using the traditional approaches of economics. In other words, the market solution and oil industry self-discipline will fail to solve the problem. Therefore, the policy consideration will be the optimal choice for the government to take into consideration. In addition, it is necessary to understand the special features in case of reasonable policy consideration on oil pollution liability.

[115] See Brown, L.R. *Eco-Economy: Building an Economy for the Earth* (W. W. Norton & Co.Ltd), at pp.26-72.
[116] *supra* footnote 13, at p85.

Firstly, the environmental damage of oil pollution is the negative externalities. The spilt oil does cause the serious treat to the health and/or life of ocean ecological system as well as mankind though any other forms. To see how externality occurs, the safety and health related costs should be divided into economic costs and non-economic costs or private costs and social cost or direct costs and indirect costs.[117] One reason for which externalities occur is the failure of the market to price the pollution damage. Another reason is the lack of property rights, as mentioned before, which makes the suffered unable to demand the externality to be reduced or ask for compensation. In reality, such cost may persist for a long time and are difficult to evaluate and compensate.

Secondly, the high transaction costs associated with the settlement of the externalities between parties is another major cause of externalities. The main reasons of such high transaction costs are mainly two aspects: one is the difficulties of acquiring necessary information for pursuing claims by victims; another one is to prove causation linking the occurrence of damage to the oil spill. Whenever an externality is negative and not compensated for, it is said to have an external cost. If such an external cost is paid for, in the form of compensation, then the externality is internalized.[118]

4.2 Theoretical Framework of Economic Analysis on Regulation Options

4.2.1 Ocean Environment Management

A certain level of ocean pollution can be tolerated in favour of maritime transport activities mainly because the natural environment, e.g. the open seas, which receives polluting products from ships and other sources, has a kind of assimilative capacity. This means that it can receive a certain level of waste, degrade it and convert it into harmless products. Consequently, one basic rule for ocean

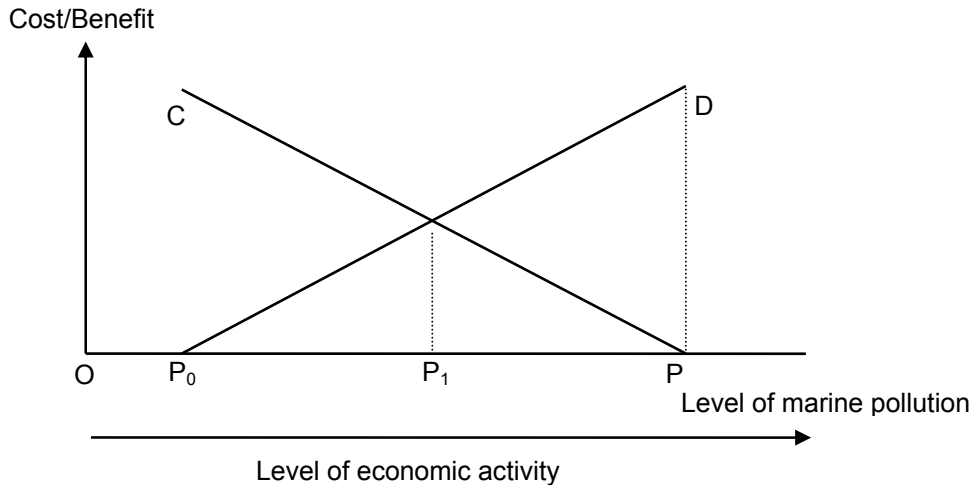
[117] See Dorman, P. "The Economics of Safety, Health and Well-Being at Work: An Overview", In focus Program on SafeWork (ILO), May 2000, at pp.29-31.
[118] *supra* footnote 13, at p.93.

environment management is to always keep waste flows to the sea at or below the assimilative capacity of the environment.

However, the situation is not quite as simple as it appears. The natural assimilation or the process of degradation and conversion can only complete over a certain periods of time. Thus, a loss from pollution would be registered even the level of pollution is within the environment's assimilative capacity. In this particular regard, shipping industry has been in an unfavourable position.

As the environment has an assimilative capability, ocean environment management could be examined at two levels, which can be illustrated as the following Figure 7.

Figure 7: Ocean Environment Management



(Resource: Maritime Economics, p.129)

The first level is illustrated by OP_0.in the above Figure 7. This is called a zero-economic-cost pollution level. In this phase, there is no need for intervention because the degree of pollution is not only within the ocean's assimilative capacity but it does not generate any economic cost. When the economic production is at a low level, pollution from ships can be within the environment's assimilative capability and incurring no economic costs. Similar situation can still be found nowadays in

some parts of the world where economic activities are mainly carried out in a traditional way.[119]

The second level refers to the pollution level higher than P_0. Then, the degree of pollution exceeds the natural assimilative capability and an external cost occurs. At this level, the objective of environment is to make sure that the polluter covers the external cost. If this is properly done, the optimal level of pollution can be reached at P_1. With other conditions remain constant; the relationship between the pollution level and economic activity is linear, which implies that additional preventive measures may allow an increase in the economic activity without resulting in a higher pollution level.

As for as ocean environmental costs are concerned, they consist of the corrective cost by compensating the pollution damage and the preventive cost by reducing the pollution level to P_1. In Figure 7, the corrective cost is the cost represented by the area P_0xP_1. Examples for the corrective costs in ocean environmental management are the clean-up costs for oil spills, or the compensation payment to a local community for the relocation of its seaside activities due to a marine pollution, etc. if the pollution level is lower than P_1, the correction cost will be less than benefit, so the polluter will increase pollution and pay for the corrective cost. If the pollution level is higher than P_1, corrective cost is higher than the benefit, the pollution level is to be reduced.

The preventive cost is involved in the reduction of pollution level to P_1. Typical examples of preventive cost are the costs related to reception facilities at ports, extra construction and operating costs for double bottom tankers, etc. The preventive measures can help keeping the pollution not to exceed the optimal level (P_1). It is important to note that the preventive cost is worth spending only if it is lower than the additional benefit that can made due to the preventive measure.[120]

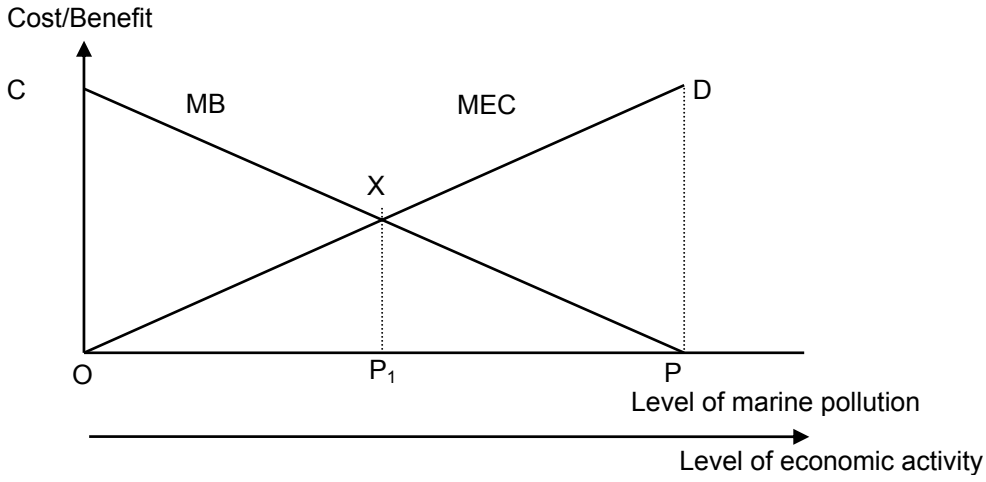
[119] *supra* footnote 25. Dr.Xu also discussed their relationship between the level of activity and level of care. See *supra* footnote 13.
[120] *supra* footnote 103, at p. 129.

In conclusion, it is clear that zero pollution is not a realistic solution in economics of environmental management. The objective is given the maximization of net social benefit while the pollution should be kept at an optimal level, where the marginal benefit equals the marginal external cost of pollution. Obviously, preventive costs should not be higher than the extra benefit made out of the increased activities.

4.2.2 Optimal Pollution Level

Rationally, society should manage the risk of marine oil spills by maximizing the benefits of importing oil, net of costs due to accidents. A liability limit for tanker industry presents an interesting problem in the economics of liability. For example, unlike most liability problems, in which both injurers and victims are members of the same society, the tankers calling on one state's ports are different, for instance, Japanese-owned is predominantly in Japan in contrast with foreign-owned predominantly in US. The oil transport industry is international and foreign tankers are highly mobile. Also, most foreign shipowners obtain liability insurance through their membership in P&I clubs. Liability from shipping operations has long been limited according to the size of the vessel. Historically, this limit has been set through negotiations.[121]

Figure 8: Optimal Pollution Level



(Resource: Maritime Economics, p.128)

[121] *supra* footnote 5, at p.32. Dr.Guaci, M. had the same expression in his lectures on the *Law of Marine Polluion* at the World Maritine University, in 2006, at Malmö, Sweden.

In Figure 8, the level of pollution (P) is shown on the horizontal axis. Cost and benefit levels are shown on the vertical axis. MB is 'marginal benefit' of polluting activity. MEC refers to 'marginal external costs' generated by the pollution to third parties.

Assuming other conditions remain constant, in the maritime transport, the more shipping activities produce, marine pollution level will be higher. Following the rule of declining rate of return, from certain moment as the level of pollution increase, the marginal benefit of the polluting activity will slide down. The higher the pollution level, the more difficult natural assimilation and the more costly the pollution correction process will be. As MB and MEC are marginal curves, the area under CPO is the total benefits and the area under DPO is the total external costs. As the aim of the oil liability policy is to maximize the total benefits minus the total costs, the optimal level of pollution will be at P1.

Recent changes in the international liability regime for oil pollution damage have intensified a policy debate about limits on environmental liability, such as in EU, US and Japan. Economic theory suggests that some type of limit may be needed under certain conditions, and that such a limit should be set so that the marginal social benefit and cost are equal.[122] However, it is unclear under which conditions no liability, limited liability or unlimited liability is desirable. Furthermore, it is unclear specifically how a liability limit may be determined for tanker shipping in certain states when a limit is desirable.

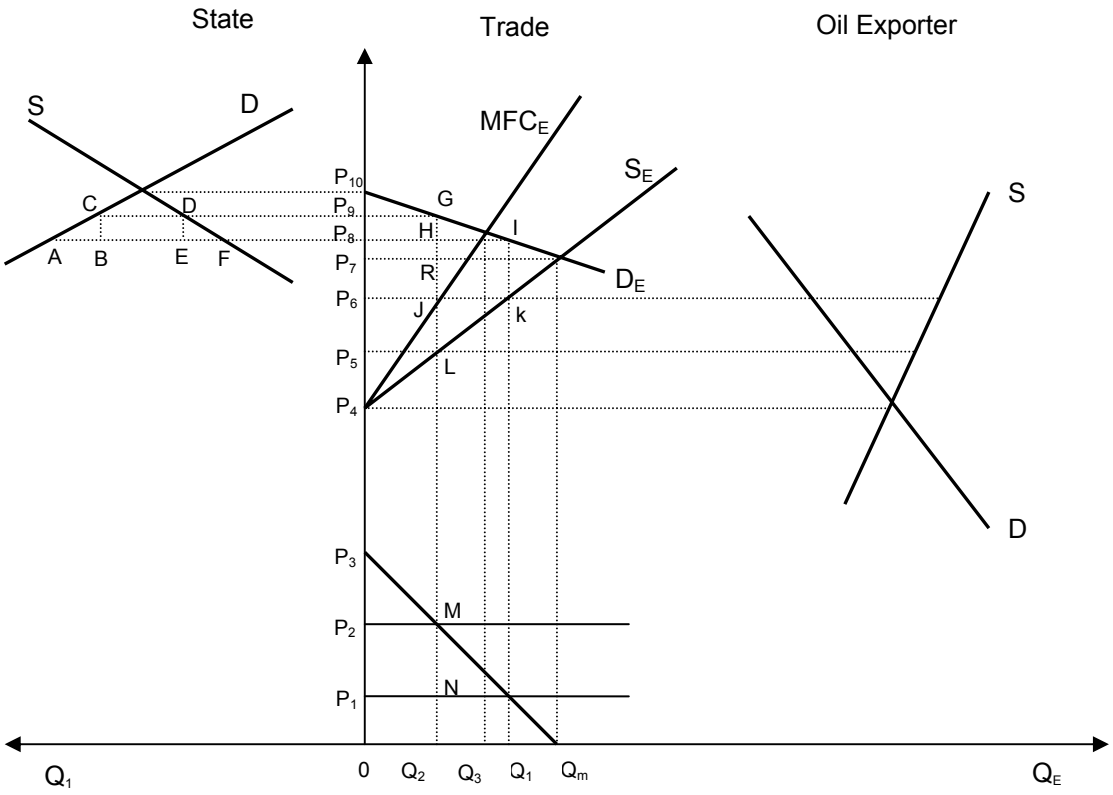
4.3 Theoretical Model to Describe the Oil market and the Shipping Market

[122] *supra* footnote 11, at p. 134. The economic analysis of optimal pollution level may allow us to better understand particular features of international environmental regulations. At the international level, when a new regulation is to be established, naturally every country will examine the implications of the regulation to the country in terms of cost and benefit. When "benefit of having the pollution = cost of having the pollution", the pollution is at its optimal level. In addition, when "benefit of the regulation = cost of the regulation", the pollution is at its optimal level.

4.3.1 An Analytical Framework for the Oil Import

To illustrate oil market and demand for shipping, services, Shneerson put forward to a 'back-to-back' graph to discuss benefit measurement of shipping by analyzing the quantity of exporting and importing countries measured from left to right and right to left.[123]

Figure 9: Linkage between State Oil Imports and the Shipping Market



(Source: Di Jin, 1999, at p.80.[124])

We assume that in Figure 9 the oil exporter's market represents the world oil market. Then, one state demand for oil imports (D_E) and the oil exporter's supply of oil exports (S_E) are derived by subtracting horizontally the domestic supply (S) from

[123] See Shneerson, D., "*On the measurement of benefits from shipping services*". Maritime Policy and Management 1977(4), at pp.277-280.
[124] See Di, Jin. "*On the optimal environmental liability limit for marine oil transport*". Transportation Research Part E 35 (1999), at pp.77-100.

demand (D) in the two markets, respectively. The demand of shipping oil to one state (D_T) can be traced by subtracting vertically the supply of export (S_E) from demand for imports (D_E). If the shipping charge (freight rate) is zero, the free trade equilibrium price and quantity are Q_m and P_7, respectively. If freight rates exceed P_3 ($=P_{10}-P_4$), no trade will take place and the quantity shipped is zero. If freight rates are between 0 and P_3, the quantity shipped will be in the range between 0 and Q_m. For instance, if the freight rate is P_2 ($=Q_2M=GL$), than the quantity is Q_2.

Firstly, when the freight rate is P_2 ($=P_9-P_5$), the total transport cost is P_2Q_2, or the area P_9GLP_5. Although this is paid by the shipper, the total cost is in fact shared by importer and exporter. The payment by importer and exporter is area P_9GRP_7 and P_7RLP_5, respectively. This is because, although the importer pays freight rate P_9-P_5 ($=P_2$), it pays a lower price for oil (P_7 reduced to P_5). This fraction of the freight rate (P_7-P_5) is effectively paid by the exporter as oil price is lowered by the same amount.[125]

Secondly, this figure can also be used to analyze welfare changes associated with changes in freight rates. Suppose the cost of shipping is P_1, but the firms overcharge and increase the freight rate from P_1 to P_2. Quantity imported declines from Q_1 to Q_2, and oil price in the state market rise from P_8 to P_9. Noting that $Q_1=AF$ and $Q_2=CD$, the reduction in imports (Q_1-Q_2) leads to an increase in state domestic oil production (EF) and a decrease in consumption (AB). Welfare losses to the state are the area ACDF ($=P_9GIP_8$), when transportation is provided by a foreign tanker fleet. However, if oil is transported by a state tanker fleet, then payment BCDE (rent) goes to the state tanker industry and the net losses are the sum of ABC and DEF (=GHI).

Thirdly, the increase in freight rate also affects the exporter. The net losses are JKL. The total net loss of importer and exporter is captured by the area MNO under the demand curve for shipping service. Now, suppose the freight rate is zero and the state has monophony power in the international oil market. The optimal import level

[125] See Marlow, P.B., *"The indirect benefits of shipping to a national economy"*. Maritime Policy and Management 1976 (4), at pp.117-119.

will be determined by marginal factor costs (MFC_E). As a result, Q_3 ($<Q_m$) should be the quantity imported.

Therefore, D_T captures the demand for shipping by both importer and exporter, welfare changes in the state cannot be analyzed by examining D_T alone. However, if the supply of exports (S_E) is perfectly elastic (a horizontal line), D_T can be used for such analyses.

To sum up the function of Figure 9, the following equations can illustrate the relationship among them. The demand for imports (D_E) and supply of oil (S_E) can be modeled as

$$p_d = p_d^0 - k_d q \quad (1)$$

$$p_s = p_s^0 + k_s q \quad (2)$$

where, p_d^0 and p_s^0 are choke prices and k_d and k_s are slopes of the demand and supply functions, respectively.

Thus, the demand for shipping is

$$p_t = p_t^0 - k_t q \quad (3)$$

where, $p_t^0 = p_d^0 - p_s^0$ and $k_t = k_d + k_s$.

4.3.2 Externalities and Liability Limit

Liability rules are designed to force shipping firms to internalize the social cost associated with oil spills, such as environmental damage and clean up cost.[126] However, the internalization of environmental externalities will lead to higher shipping costs and a lower level of imports will happen accordingly. For example, in Figure 9, if the marginal cost of shipping increases from P_1 to P_2 due to internalization, the quantity will be reduced from Q_1 to Q_2. Furthermore, if oil spill damages are greater than P_3, there should be no imports.

'Liability limit' can be defined as the limit on industry's payment for environmental damage associated with oil spills per unit of oil transported to society.[127] Let x be the environmental damage per unit of oil transported (e.g., dollars per ton), x is a

[126] *supra* footnote 13.
[127] *supra* footnote 11, at p.81.

stochastic variable that follows a probability density function φ(x) with $x_{min} \leq x \leq x_{max}$, m and σ^2 are the mean and variance of x, respectively. Then, for a liability limit (x_1), the unit damage absorbed by industry (x_i) is x if $x \leq x_1$ and x_1 if $x > x_1$. The analysis is based on the assumptions that all spills are detected, the associated damage is known, and the court system functions perfectly. Generally, $x_{min}=0$ and $x_{max}=\infty$. In the two extreme cases, no liability implies that $x_1 =0$ with $m_i = \sigma_i^2 = 0$, $m_s = m$ and $\sigma_s^2 = \sigma^2$. By contrast, full (unlimited) liability means that $x_1=\infty$ with $m_i = m$, $\sigma_i^2= \sigma^2$, and $m_s= \sigma_s^2=0$. These assumptions are reasonable as most spills are detected and documented by the US Coast Guard, and damage assessment is required by relevant laws.[128]

An important function of oil spill liability laws is to provide firms with incentives to take care to avoid oil spills, the socially optimal level of care under different liability regimes has been examined by Shavell[129] and Segerson.[130] The shortage of this model is that the level of care as a choice variable is not included.

4.4 WTA

4.4.1 Introduction to WTA

'Willingness to accept' (WTA) is used to measure the external cost of a pollution benefit. The idea is to find out what people would accept as the amount of compensation to tolerate a pollution incident. The appropriate ocean environmental management can only achieve their objective when the optimal pollution level is identifiable. The economic benefit of a maritime transport activity – an environmental pollution source – will depend on a basic concept called 'individual preferences'. By aggregating the individual preference, we can secure total preferences for the

[128] See Grigalunas, T.A., "*Liability for oil spill damages: issues, methods, and examples*". Coast Management 1998 (26), at pp.61-77.
[129] See Shavell, S., *Economic Analysis of Accident Law*. Harvard University Press, Cambridge, MA, 1987.
[130] See Segerson, k., "*Risk-sharing and liability in the control of stochastic externalities*". Marine Resource Economics, 1987 (4), at pp.175-192.

society. However, the economic analysis of optimal pollution level demonstrates that the external cost of pollution includes an element measured in WTA.[131]

Obviously, the income level is one of important influential factors to the WTA. As for the optimal level of pollution, clearly income level is not the only parameter to be taken into consideration. People may not be able to fully realize the potential danger of pollution disasters caused by some economic activities and be ready to pay for the prevention of them by applying stricter regulations. In reality, people's WTA may only increase dramatically to a higher level after big pollution events. In this respect, the media can play an important role in influencing the WTA level.

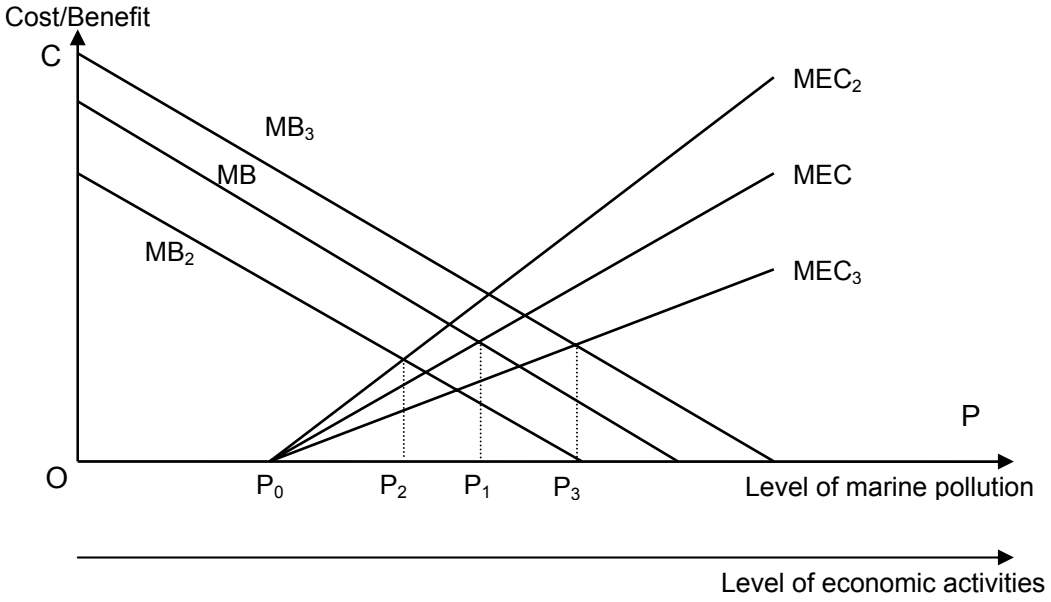
4.4.2 Income Level and WTA

As discussed above, the income level has a strong influence on the WTA level. The difference of optimal pollution level for different persons, communities, regions or countries is illustrated in Figure 10.

While country A has its optimal level at P_1, country B's optimal level is at P_2. It means that it benefits less from the polluting activity but has to pay a high cost for corrective and preventive measures due to a higher national income. Likewise, country C may have its optimal pollution level at P_3 with higher marginal benefit and lower marginal external cost level with the pollution.

[131] See Biervliet, K.V., "*A Contingent Valuation study of an accidental oil spill along the Belgian coast"*. Marine Resource Damage Assessment: Liability and Compensation for Environmental Damage. Frank Maes, Published by Springer, 2005. at pp.166-207. in this research, the Contingent Valuation (CV) method is introduced to estimate the welfare change in monetary terms by using a CV questionnaire. "Willingness to pay" (WTP) is used in this research. As for the meaning, both WTP and WTA have the same meaning in this sense.

Figure 10: The Relationship between Marginal Benefit Level and Marginal External Cost Level



(Source: Maritime Economics, at p133)

The difference in optimal pollution level is the biggest difficulty for policy makers and the establishment and implementation of effective environmental regulations. It is believed that the impact (both benefit and cost) of pollution should determine the application scope of relevant environmental regulations to see whether regulations should be better implemented at regional or national or international level.[132] The marine environment regulations should be made according to the optimal pollution level based on the average MB and MEC so that the maximum net benefit is obtained for the society.

4.4.3 Classification of Income Level among the States to CLC and Fund

The World Bank puts forward the concept of 'GNI per capita' to classify the economies of states. This can be the optimal parameter to distinguish the income level at the national level. From time to time, the actual standard of the income level

[132] *supra* footnote 11.

increases annually with the world development in the economy's measured level of GNI per capita. Nevertheless, this is an acceptable indicator among the international societies.

According to the World Development Report 2004,[133] 'GNI per capita' is used to determine the following income classification as shown by the following Table 8.

Table 8: The Income Level Classified by GNI-per CAPITA

Income level	low	Lower-middle	Upper-middle	high
GNI-per captia	≤ $735	$736 ~ $2,935	$2,936 ~ $9,075	$ 9,076

(Source: http://www.worldbank.org/data/wdr2004.pdf)

The world classification of economies by region and income in 2004 is illustrated in the selected world development indicators among the world development report. 'Gross national income' (GNI) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in current U.S. dollars converted using the World Bank Atlas method. 'GNI per capita' is gross national income divided by midyear population. In calculating GNI and GNI per capita in U.S. dollars for certain operational purposes, the World Bank uses the *Altas* conversion factor. The purpose of the *Atlas* conversion factor is to reduce the impact of exchange rate fluctuations in the cross-country comparison of national incomes.

As for as this research is concerned, only the countries to the party members of the CLC and Fund are concerned. As at 7 June 2006, there are 94 States Parties to both the 1992 CLC and the 1992 Fund; meanwhile, 17 states are Parties to the 2003 Supplementary Fund Protocol. However, there are still 16 states Parties to the 1992 CLC but not the 1992 Fund.[134]

[133] See the World Bank "*World Development Report 2004 -Making Services Work for Poor People*", Oxford University Press, online available at http://www.worldbank.org/data/ .
[134] See the IOPC FUND website at http://www.iopcfund.org .

In respect to the income level, all the 17 states to the 2003 Supplementary Fund belong to the high income level. Among the 16 states to the 1992 CLC but not to the 1992 Fund, only 2 countries (Kuwait and Saudi Arabia) are on the high income level. One country (Chile) belongs to the upper-middle income level. The other 13 countries fall into the lower-middle income level. In other words, above 80% countries among this section are on the lower-middle income level. To discuss the reason, the Kuwait and Sandi Arabia are all the main oil produced countries. One strange phenomenon is that China hasn't ratified the 1992 Fund although she has become the third biggest oil importer since year 2005. As mentioned in the previous chapters, US, the biggest oil importer of the world, set up its domestic oil pollution fund, which is not in the international regime. Another typical country is Japan, who is the active party to the international fund convention since she is the main oil importer country. The following section attempts to conduct an economical analysis on their different liability choices.

4.5 Chapter Conclusion

Maritime environment is an economic issue based so that the oil pollution liability could fall into the economics analysis. In other words, the establishment of the maritime environment regulations on oil pollution is not only a technical issue but also an economic issue. The property right and externalities are two basic factors among this regime. The economic analysis of the oil market and tanker market provides tools and a systematic approach to define the risks associated with shipping activities and to measure the optimal risk level, which is expected to be achievable with the reasonable regulations.

The concept of WTA is introduced in this area to explain what people would accept as the amount of compensation to tolerate a pollution incident. There are limitations to conduct detailed analysis on this field lack of enough information in selected countries. However, the whole condition of the income level of parties to CLC/FUND is analyzed by the data of GNI. The following chapter will discuss the policy options on oil pollution liability in the selected countries.

CHAPTER 5

5 Case Studies

The policy consideration on oil pollution liability is greatly dependent on political factors, domestic legislation, economic analysis and other factors in a sovereign state. As discussed in the previous sections, the optimal policy regarding oil liability will also depend largely on the characteristics of the shipping market.

This chapter first highlights the liability options as well as the Maritime Dependence Factor (MDF), which follows as the aggregate situation of oil import market and shipping markets. Typical countries are given the details that influence the liability options such as US, Japan and China. Finally, it concludes that the elasticity of oil supply and demand and the competitiveness of shipping markets are key factors affecting liability policy.

5.1 Introduction

5.1.1 Liability Options

Economic theory suggests that some types of limit may be needed under certain conditions, and that such a limit should be set so that the marginal social benefit and cost are equal.[135] However, it is unclear under which conditions no liability, limited liability and unlimited liability is desirable.

As for one particular oil spill accident from tanker, the goal is to have the oil pollution damage compensated. However, a liability limit for the tanker industry presents an interesting problem in the economics of liability. For example, unlike most liability

[135] *supra* footnote 11.

problems, in which both injurers and victims are members of the same society, the tankers calling on one state's ports are predominantly foreign-owned or flag-owned. The oil transport industry is international and foreign tankers are highly mobile. Also, most foreign shipowners obtain liability insurance through their membership in P&I clubs. Liability from shipping operations has long been limited according to the size of the vessel. Thus, the oil liability options will not depend on one social goal to maximize social welfare, which is not too justice at the aggregate level.

5.1.2 Proposition

As for the category of tanker industry in one country, there have been a small number of studies on the market structure of the tanker industry. While the majority of researchers believe that the market is competitive, others have shown that the market structure has changed over time and that the market has become differentiated by vessel size and trade route.[136] In this research, it examines two scenarios: competitive market and monopoly market.

Due to the limitations of data, it is relatively difficult to conduct the exact mathematic simulation. However, Jin pointed a group of necessary data as following.[137]

- To know tanker operating revenues and cost. There are a number of factors influencing the assessment such as trade routes, vessels sizes and age, etc. The oil supply markets are also considered.
- To specify the risk preference measures. The risk aversion parameter for the industry is calculated from a shipowners' utility function, which is also hard to estimate.

Therefore, to solve this problem, the qualitative method is introduced in terms of general description of the whole situation of tanker industry in one country.

5.1.3 Maritime Dependence Factor

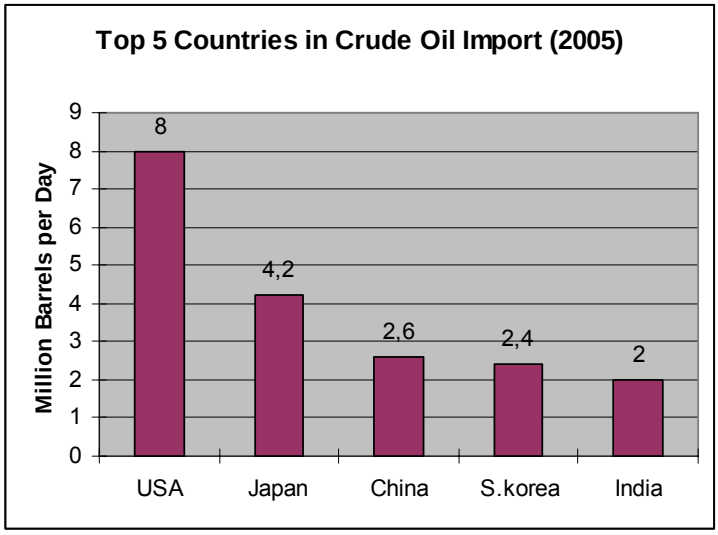
In order to know which country is more dependent on maritime transport and which country is less, as to the situation of each individual economy, the concept of the

[136] *supra* footnote 103.
[137] *supra* footnote 121, at p.91.

'Maritime Dependence Factor' (MDF) was introduced. MDF is equal to the amount of the country's international seaborne cargo in value and compare this with the country's GDP. Obviously, this indicator will change accordingly year on its exact number. Nevertheless, the whole trend of the MDF among countries is relatively fixed.

Ma conducted a calculation by selecting some countries in 2003.[138] Among this data, the MDF of Japan, US and China are 20%, 11% and 10% respectively. If the value of the imported crude oil is available, then the crude oil shipping dependence factor will be easily counted. This indicator could be one of the key factors to express the social wealth of tanker shipping in one country. Figure 11 indicates the quantity per day of the five biggest crude oil importers in the world.

Figure 11: Crude Oil Import of Selected Countries in 2005



(Source: BP oil transport statistics 2005)

The US is the biggest oil importer of the world, which is bigger than the sum of Japan and China in terms of quantity. Recently, China becomes an important oil importer as the driving force of the development of the global economics. Meanwhile,

[138] *supra* footnote 103, at p.12.

these three countries are also the biggest economic entities of the world. However, they made different choices with regard to the oil liability regime.

5.2 Case 1: US

The United States (US) imports about 8.5 million barrels of oil per day, which accounts for nearly 50% of its total consumption.[139] Seventy per cent of the imports are carried in foreign independent tankers. US adopted the OPA 90 as its policy option to deal with the oil pollution liability.

5.2.1 Tanker Fleet

According to the official data and economic analysis issued by US. Department of Transportation in 2006, the recent US-Flag tanker fleet decrease steadily. The Table 8 shows the change of US-flag tanker fleet in amount of number and DWT from 2001 to 2005.

Table 9: US-Flag Tanker Fleet (DWT: Million)

Year	2001		2002		2003		2004		2005	
	No.	DWT	No.	DWT	No.	DWT	No.	DWT	No.	DWT
US-Flag	84	5.5	77	5.2	68	4.3	60	4.4	58	4.3

(Source: retrieve from www.marad.dot.gov/marad_statistic)

Table 9 indicates that both the number and capacity of US-Flag Tankers decrease steadily in recent five years. This means more and more US tanker owners prefer to apply the FOC.

During the same period, the following Table 10 shows the detailed difference between US-flag and foreign flag tankers, which call at US ports.

[139] *supra* footnote 121, at p.77. In addition, this data is published from the US Department of the Interior in 1995.

Table 10: Tanker Capacity Calling at US Ports by flag 2001-2005

Flag/Type	2001	2002	2003	2004	2005
US-Flag	(Thousand DWT)				
Crude and product	268 050	246 176	273 399	248 801	267 793
Crude carriers	151 165	145 954	176 822	149 625	164 576
Foreign-Flag	(Thousand DWT)				
Crude & product	1 006 401	956 037	1 065 970	1 116 640	1 181 831
Crude Carriers	680 217	650 597	746 931	779 735	821 343

(Source: retrieve from www.marad.dot.gov/marad_statistic)

From the Table 9 and Table 10, we could conclude the majority of crude oil and oil products are carried by the Foreign-Flag tankers in US.

5.2.2 Liability Analysis

Since the foreign tanker industry is coordinated through shipowners' associations and P&I clubs, they may have market power.[140] In this section, we consider the case when the foreign tanker industry has monopoly power in the US society. Under this scenario, there are two decision makers: the foreign tanker industry and US society. The industry chooses a level of activity for any given liability limit. Society chooses an optimal liability limit subject to industry's response. An interior solution to this problem is an equilibrium at which industry's activity level and society's liability limit are jointly determined.

Furthermore, Hartwick and Olewiler concluded that US was a monopoly importer of oil.[141] As discussed in the previous section, the foreign tanker has monopoly power in the US society. Based on this condition, Jin made a model analysis on the optimal environmental liability limit for marine oil transport.[142] This research concludes that,

[140] See Pirrong, S.C., An application of core theory to the analysis of ocean shiping markets. Journal of Law and Economics, 1992 (2), at pp.89-131.
[141] See Hartwick, J.M., Olewiler, N.D., *The economics of natural resource use*. Harper and Row, 1986, New York.
[142] *supra* footnote 121, at. pp.84-85.

"In reality, it is a competitive tanker supply market in US. …. if the shipping market is competitive, then full (unlimited) liability is desirable, regardless of the risk preferences of the shipping firms and the society."

It is important to note that the implementation of OPA 90 regulations has not lead to any significant reduction in tanker supply or oil imports. Thus, we know that when the shipping market is competitive, the optimal import level can be achieved through liability policy only when the oil market supply is perfect elastic and both the firms and society are neutral. In other cases, although full liability can only lead to a lower level of imports closer to the socially optimal level, the amount of imports is still greater than the socially optimal level. In this case, OPA 90 liability policy is an appropriate choice.

5.2.3 Discussion

With respect to oil pollution problems, the US continues to favour domestic rather than international law. This selectivity results from the following reasons. First, the conflict between federal and state interests can cause a failure of the executive branch to obtain Senate approval of an international treaty because the international treaty, premised on uniformity in maritime law, would have pre-empted on uniformity in maritime law, would have pre-empted state laws.

Second, the development of US maritime law has historically diverged from the approaches of the maritime law in the continental countries. Because of the incompatibility with US laws and policies, the US did not join the international regimes.[143]

Third, a treaty is the result of a compromise between competing and conflicting commercial, political and environmental interests and thus is formulated in general terms to be flexibly interpreted.[144] However, this flexibility has limitations with respect to the liability limits or responsible parties. The lower liability limits and narrower category of responsible parties relative to those under the US federal and

[143] *supra* footnote 7.
[144] *supra* footnote 5, at pp.134-135.

state regimes as a result of negotiation have seldom been sufficient to induce the US to join international conventions.

Some experts also argued that an import tax on tanker owners may be used to maximize the net social benefit because the US is a monopoly importer of oil. However, the tax is not politically popular for several reasons. It increases the price of oil to consumers. The tax has possible adverse effects on world oil trade.[145]

Besides that, there are other direct reasons for the US unilateral approach for oil pollution liability. One is because coverage under the CLC/FUND was inadequate to cover pollution costs from major oil spills. The liability limit under CLC was set at approximately US$20.3 million, but the US sought a minimum of US$50-60 million. Another one was ambiguous definition of 'pollution damage' under the international conventions. The adoption of an acceptable definition of 'pollution damage' was difficult because of different notions in the various countries about what constitutes damages. These different notions led to the adoption of a general definition with the result of a varied interpretation among the national jurisdictions.[146]

5.3 Case 2: Japan

Generally, Japan takes the principle of "Limited liability for ship owner, limited liability for oil receiver" in the regime of oil pollution liability. Japan, totally reliant on imported oil, imported 210.4 million tones crude oil in 2005 as well as 47.8 million tones product oil. It accounts to import about 4.2 million barrels crude oil per day in 2005.

5.3.1 Tanker Fleet

As for the tanker fleet, Japanese-registered vessels stand for 80%-90% of its supplies. At the end of July 1, 2004, Japanese flag tanker has reached the 40,469,000 dwt in amount of 797 tankers, which locates the second biggest tanker fleet after the Greece.

[145] *supra* footnote 13.
[146] *supra* footnote 7.

5.3.2 Liability Analysis

Japan was an original member of the International Oil Pollution Compensation Funds. It is a party to the 1992 Civil Liability Convention, which governs the exposure of shipowners, and the 1992 Fund Convention, where contributions are essentially sourced from the oil industry. Japan is also one of the relatively few numbers of states that have become members of the Supplementary Fund, a third tier of compensation.

In terms of the condition of Japanese crude oil trade, it satisfies the condition "when the tanker industry is Japanese owned and has market power, a liability limit may be desirable". That is the general principle that Japan adopted the international oil pollution liability regime.

5.3.3 Discussion

As a major oil receiver, Japan is the largest contributor to the 1992 Fund. In 2004, Japan was responsible for 18% of general fund contributions, comfortably ahead of the second largest nation, Italy, with 10%. In terms of the Supplementary Fund, Japan's exposure is even greater – it is responsible for the twice as much 'contributing oil' as the second largest nation, the Netherlands.
The major problem is the unbalance between the paid contributions and the received compensation from the FUND. Since 1971, Japan became the biggest contributor to the Fund. From 1979 to 1995, Japan contributed a sum of about 82 million SDR, which was 29.1 per cent of all the contributions. However, Japan only received about 21 million SDR in return for compensation.[147] Nevertheless, Japan is still in favour of the Fund, even in the Supplementary Fund.

However, there is growing unease about Japan's position in a regime where large oil importers such as the US and China are absent. For instance, Japan is considering

[147] See Guoping, XU., *On study of the vessel oil pollution legal compensation*, Peking University Press, 2006, at p.160. In addition, the limits of liability in the Convention are actually expressed in Special Drawing Rights (SDR), which is a currency created by the International Monetary Fund. The value of SDR depends on the exchange rate at the particular time.

establishing its own marine oil pollution fund. A joint feasibility study into the potential benefits of a national fund is understood to have been triggered by the Japanese government and the nation's oil industry.

5.4 Case 3: China

The principle situation on oil pollution compensation in China is "Limited liability for ship owner, no liability for oil receiver". So far, China is only the party member to the 1992 CLC. Except for the Hong Kong (China Special Administration), China didn't sign the 1992 Fund.

5.4.1 Tanker Fleet

China has imported 2.6 million barrels crude oil per day in 2005. However, this market is dominated by foreign flag tankers, such as South Korean tankers. In contrast, in 2004, there are only 10%-12% of Chinese oil imports by sea come in on China-flagged tankers. The total capacity of 327 tankers is 9,216,000 DWT in China-flag tankers fleet until 2004. The detailed condition is in the Appendix 2.

5.4.2 Liability Analysis

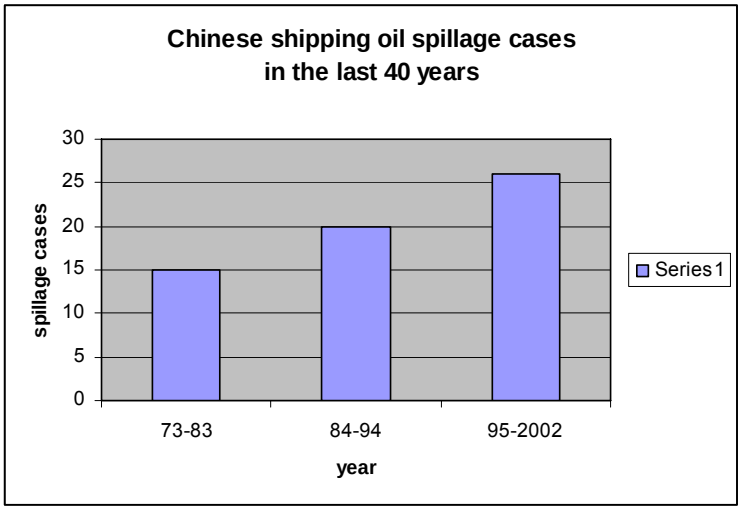
China, who has become one of the biggest economic production centres, increased its oil trade during the last decades. Since 1995, China crude oil consumption has surpassed crude oil production. From 1996 on, China has turned to be a net importer of crude oil, and the importers of crude oil keeps increasing steady while exports decrease. Based on the BP statistical review of world energy 2005, the crude oil production in China is 180.8 million tonnes while the total crude oil consumption is 299.9 million tonnes. Furthermore, China's oil R/P (reserves to production) ratio is only a third of the world average figure. Since 2003, China has left behind Japan, becoming the second largest country in oil consumption.

According to BP statistics, China has an annual 160 million tonnes crude oil and oil products import. Roughly 90% of the average 2.54m barrels a day of crude oil imported to China comes by sea. According to the forecast, in 2020, China will increase its oil consumption to 450 million tonnes and thereby 250 million tonnes oil shall be imported. In this case, the foreign tanker industry has monopoly power and demand for oil imports is not perfectly elastic. Thus, limited liability may be desirable.

5.4.3 Discussion

The current liability regime doesn't suitable for the increasing oil importer in China. Firstly, the risk of oil spillage accidents is relatively high along Chinese coast line. According to data from the Ship's Position Report Center, there are about 200 oil tankers along the Chinese coast everyday.

Figure 12: The Oil Spillage Accidents in China during the last 40 years



(Source: China's MSA[148])

The data in Figure 12 shows more than 60 incidents took place from 1973 to 2000,, involving more than 50 tonnes of oil spillage each. Tremendous resources were used for the cleaning up of thousands of tones of oil spillage.

[148] China's MSA means the Maritime Safety Administration in China. The data is collected by Hua, Lu., 2004.

Secondly, the data also shows that China's pollution arising from oil tanker spillage over the past 40 years has increase steady, which not only adversely affected the ocean ecology but also resulted in great economic loss.

Following increasing accidents and pollution by tankers over recent years, claim disputes continue to rise. When tankers fail to pay the premiums for oil pollution liability insurance, they are unable to compensate and this causes great difficulties for marine safety administrative departments in dealing with accidents.[149]

According to the proposal from Chinese minister of communication, a domestic oil pollution fund will established in recent years, which deals with the oil spillage liability in a short term. In a long term, China will enter into the international oil liability regime.

5.5 Chapter Conclusion

In this chapter, US, Japan and China are selected as three typical liability options in the oil pollution liability regime, which covers international regime to domestic regime. It examines the impact of liability law at the aggregate oil shipping industry, which brings the MDF to this field. It also considers that the competitiveness of shipping markets is one of the key factors affecting liability policy in a particular country. The optimal policy regarding a liability limit on oil pollution will depend largely on the characteristics of the shipping market.

[149] See Hua, Lu., "*China's Strategic Oil Reserves and the Establishment of the Oil Spill Contingency System*". Maritime Economics & Logistics, 2004, 6: pp349-359

CHAPTER 6

6 Conclusions

6.1 Conclusion

The oil seaborne trade plays a key role either in the shipping industry or in one country's economic activities. The transport of crude oil developed with the change of the world economic centre. However, the main flow of crude oil trade is relatively constant because of the characteristic of crude oil production and consumption. With regard to the historical accidental statistic, the potential tanker accidents will exist once the oil seaborne trade continue.

As far as the oil pollution regulation is concerned, the big oil spill accident and relevant convention are always interrelated. In the case of oil spills, the fact that accidental spills are probabilistic and inevitable. The big accidental oil spill has a positive impact on the maritime environment regulations in IMO. Thus, most of regulations on oil pollution are accident driven.

The legal framework of maritime environment is of primary importance in the oil compensation regime, and the relevant IMO conventions are most commonly applied in this area. As an essential legal basis for providing compensation for pollution damage and as an important tool for providing adequate deterrence *ex ante*, liability rules must be sound and meaningful. The oil pollution liability falls into the private law regime.

Maritime Environment is an economic issue, in which the principle of environmental economics can apply. However, the special features of oil spill regime, such as lack of clear definition of pollution damage, property right and externalities, bring a

challenge to conduct economic analysis on the oil pollution liability regime. The optimal level of Ocean pollution and level of activities are an important tool to balance the industry benefit and society cost. The theoretical framework of demand and supply model is discussed to analyze the policy options.

Moreover, the income level, which impacts on the WTA, is detailed discussed by the GNI of parties to the CLC/FUND. It concludes that the higher income level would like to pay more for the marine protection. Therefore, the liability limitation is higher in the mainly developed countries.

Lastly, there are a group of case studies, such as US, Japan and China, which show the whole conditions of liability options in the oil pollution liability.

6.2 Limitation of Research

The work done in this dissertation has inevitably its limitations. First, due to the complexity of maritime environment regulations, only the private law on oil pollution is selected in this research. Meanwhile, the crude oil takes the place of persistent oil in case of data collection though the area of the persistent oil beyond the crude oil. Due to the data available, only the tanker accidental oil spills are considered in this research.

Secondly, due to the difficulties in valuating marine environment as most of them are not market-priced goods, there are limitations to conduct the exact mathematic economic analysis of the maritime regulations on oil pollution.

Third, in terms of the policy programme options and of the optimal level choice, there are some main and proven economic analytical tools applicable to regulation formulation such as risk assessment, cost-benefit analysis and stakeholder analysis. However, in this research, only the oil tanker industry is considered in terms of competitive or monopoly tanker market. Furthermore, only the three countries are selected to do the practical analysis.

6.3 Challenges for Further Research

This research had aimed to focus on the policy options that will rely on the economic analysis of the maritime environment regulations on oil pollution in tanker shipping. Further research still needs to be carried out on the following aspects:

- To evaluate the interrelationship between several impacted factors and WTA.
- To combine the model of public law and regulatory law areas into the private law regime on the oil pollution. Thus, both preventive and remedial measures could be made at the optimal level.
- To distinguish different sources of oil pollution such as accidental spills, operational discharges and deliberate dumping. The economic implications of these characteristic differences need further study.
- To apply the principle of economic analysis of law not only to the tanker oil spill pollution but also to other vessel-source marine pollution.

Bibliography

BOOKS

Fearnleys. (2003). *Fearnleys' annual review 2002*. Oslo: Author.

Fearnleys. (2005). *Fearnleys' annual review 2004*. Oslo: Author.

Gauci, G. (1997). *Oil Pollution at Sea: Civil Liability and Compensation for Damage*. Chichester: John Wiley & Sons Ltd.

Hussein, M.A. (2004). *Principles of Environmental Economics*. (2nd Edition). London: TJ International, Padstow, Cornwall.

International Oil Pollution Compensation Fund 1992.(2005). *IOPC Fund Claims Manual (2005 ed.)*. London: Author.

International Oil Pollution Compensation Fund 1992.(2005). *IOPC Fund Annual Report 2004*. London: Author.

John, A.A. (2000). *Environmental Economics for Non-Economists*. London: World Scientific Publishing.

Maes, F.(2006). *Marine Resource Damage Assessment: Liability and Compensation for Environmental Damage*. Dordrecht: Springer.

Mukherjee, P.K. (2002). *Maritime Legislation*. Malmö: WMU Publications.

Pearce, D.W., & Turner, R.K. (1990). *Economics of Natural Resources and the Environment*. London: Harvester Wheatsheaf.

Rue,C.D.L, & Anderson, C.B.(1998). *Shipping and the environment*. London: LLP.

Sandvik, B. & Suikkari, S. (1997) Harm and reparation in international treaty regimes: an overview. In: Wetterstein, P, (Eds.). *Harm to the environment: the right to compensation and the assessment of damage* (pp.57-71). Oxford: Clarendon Press.

Ma, S. (2002). Economics of Maritime Safety and Environmental Regulations. In: Grammenos, C.Th.(Eds.): *The Handbook of Maritime Economics and Business* (pp 399-424). London: LLP.

Tan, A.K.J. (2006). *Vessel-Source Marine Pollution: The Law and Politics of International Regulation*. Cambridge: Cambridge University Press.

XU, G.P. (2006). *Study on Compensation Law of Oil Pollution Damage*. Beijing: Peking University Press.

United Nations Conference on Trade and Development. [2004]. *Review of Maritime Transport, 2003*. Geneva: United Nations.

Word Bank. (2005). *World Development Report 2004: Making Services Work for Poor People.* Oxford: Oxford University Press.

ARTICLES

Abecassis, D. (1983) IMO and liability for oil pollution from ships: a retrospective. *Lloyd's Maritime and Commercial Law Quarterly*; 46-52.

Garick, J.A. (1993). Crisis in the oil industry certificates of financial responsibility and the oil pollution act of 1990. *Marine Policy,* 272-293.

Gauci,G. (1995). Limitation of liability in maritime law: an anachronism? *Marine Policy, 19* (1), 65-74.

Gauci, G. (1999). Protection of the marine environment through the international ship-source oil pollution compensation regimes. *Review of European Community & International Environmental Law 8* (1), 29-36.

Grigalunas, T.A. (1998). Liability for oil spill damages: issues, methods, and examples. *Coastal Management, 26*, 61-77.

Hanemann, W.M. (1994). Valuing the Environment through Contingent Value. *Journal of Economic Perspectives, 8* (4), 19-43.

Holt, M., & Cecil, G.R. (1995). Natural resource damages for oil spills: the international context. *Natural Resources and Environment, 1995* (9): 28-31.

Hua, Lu. (2004). China's Strategic Oil Reserves and the Establishment of the Oil Spill Contingency System. *Maritime Economics & Logistics, 6*, 349-359.

Jacobsson, M. & Trotz, N. (1986). The definition of pollution damage in the 1984 protocols to the 1969 civil liability convention and the 1971 fund convention. *Journal of Maritime Law and Commerce;17*, 467-470.

Katkar, K.W. (1995). Protection of marine resources: the US oil pollution act of 1990 and the future of the maritime industry. *Marine Policy, 19* (5), 391-400.

Kim, I. (2002). Ten years after the enactment of the Oil Pollution Act of 1990: a success or failure? *Marine Policy*, *26*, 197-207.

Kim, I. (2003). A comparison between the international and US regimes regulating oil pollution liability and compensation. *Marine Policy*, *27*, 265-279.

Ma, S. (1995). Economics of Ocean Environmental Management – Optimal Pollution Level and Environmental Regulations. *IAME Conference,* MIT 1995.

Marlow, P.B. (1976). The indirect benefits of shipping to a national economy. *Maritime Policy and Management, 4*, 117-119.

Mason, M. (2003). Civil liability for oil pollution damage: examining the evolving scope for environmental compensation in the international regime. *Marine Policy*, *27*,1-12.

Mikelis, N. (2005).Tanker safety record at all-time high. *IMO NEWS, 4*, 14-16.

Mikelis, N. (2006, February 17). Analysis uncovers tanker fleet pollution surprises. *Lloyd's List*, p.7.

Monnier, I. (1995). The cost of oil spills after tanker incidents. *Joint MIT-Industry Program on Tanker Safety Report No.41*. Cambridge: Department of Ocean Engineering, MIT.

Papanikolaou, A., Eliopoulou, E., & Mikelis, N. (2005). Critical Review of AFRAMAX Tankers Incidents. *3rd International Conference ENSUS*, Newcastle upon Tyne, 13-15 April 2005.

Papanikolaou, A., Eliopoulou, E. & Mikelis, N. (2005). Systematic Analysis and Review of AFRAMAX Tankers incidents. *11th International Association of the Mediterranean Congress IMAM*, Portugal, 26-30 September 2005.

Pirrong, S.C. (1992). An application of core theory to the analysis of ocean shipping markets. *Journal of Law and Economics, 36*, 937-976.

Segerson, K. (1987). Risk-sharing and liability in the control of stochastic externalities. *Marine Resource Economics, 4*, 175-192.

Segerson, K. (1989). Risk and incentives in the financing of hazardous waste cleanup. *Journal of Environmental Economics and Management, 16*, 1-8.

Shneerson, D. (1977). On the measurement of benefits from shipping services. *Maritime Policy and Management, 4*, 277-280.

Spiro, E., & Parfitt, A. (1995). Applying Cost-Benefit Analysis to Marine Safety Measures. *Maritime Policy and Management, 22* (3), 215-224.

Wilde, M.L., (2001). The EC Commission's White Paper on environmental liability: issues and implications. *Journal of Environmental Law, 13*(1), 21-37.

Xu, J.J. (2006). Theoretical Framework of Economic Analysis of Law Governing Marine Pollution. *WMU Journal of Maritime Affairs, 5* (1), 75-94.

INTERNATIONAL CONVENTIONS

International Convention on Civil Liability for Oil Pollution Damage, 1969, and Protocol 1992. (CLC)

International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971, and Protocol 1992. (FUND)

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969, and Protocol 1973.

International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto. (MARPOL 73/78)

International Convention on Safety of Life at Sea, 1974, and Protocols 1978 and 1988. (SOLAS)

United Nations Convention on the Law of Sea, 1982. (UNCLOS)

LECTURES

Mukherjee, P.K. (2006). *Law of Marine Pollution*. Unpublished lecture handout, World Maritime University, Malmö, Sweden.

Schröder, J.U. (2005). *The IMO/ILO Approach to Human Element in Marine Casualties*. Unpublished lecture handout, World Maritime University ,Malmö, Sweden.

Shuo, M. (2005). *Maritime Economics.* Unpublished lecture handout, World Maritime University, Malmö, Sweden.

Thesis

Wang, H.L. (2000). *The new international regime of liability and compensation for oil pollution damage: status and trends.* Unpublished master's thesis, World Maritime University, Malmö, Sweden.

Rha, Y.S. (1992). *A study on the compensation regime of oil pollution damage*. Unpublished Ph.D. dissertation, Hankuk University of Foreign Studies, Seoul, Korea.

INTERNET SOURCES

International Oil Pollution Compensation Funds (IOPC Fund) website, at http://www.iopcfund.org/

International Tanker Owners Pollution Federation Limited (ITOPF) website, at http://www.itopf.com/stats.html

International Maritime Organization (IMO) website, at http://www.imo.org

World Bank website, at http://www.worldbank.org/data/

Institute of Shipping Economics and Logistics (ISL) website, at http://www.isl.org/products_services/publications

U.S. Department of Transportation – Maritime Administration (MARAD) website, at www.marad.dot.gov/marad_statistic

Appendix 1

Table (1) World Crude oil seaborne trade in 2003

Figures in million tonnes

To: From:	N/W Europe	Mediter-ranean	North America	South America	Japan	Other Asia	Others	Total 2003
Middle East	67.0	55.0	132.2	9.6	181.2	348.4	34.9	828.3
Near East	0.5	19.0	0.1	0.0	0.0	0.0	0.0	19.6
North Africa	11.0	63.3	16.6	2.7	0.0	4.1	0.8	98.5
West Africa	10.5	26.5	78.6	6.6	5.3	48.2	5.0	180.7
Caribbean	5.1	8.5	187.0	15.3	0.5	5.3	0.1	221.8
South East Asia	0.0	0.3	6.9	0.0	14.2	20.5	16.5	58.4
North Sea	4.8	8.8	58.0	1.0	0.0	6.1	0.0	78.7
Others	68.3	68.5	21.8	10.2	3.6	11.9	3.1	187.4
Total 2003	167.2	249.9	501.2	45.4	204.8	444.5	60.4	1673.4

(Source: Fearnleys Review 2004)

Appendix 2

Table (2) Top 20 World Merchant Fleets by Country of Owner, Self-Propelled Ocean-going Vessels 1,000 Gross Tons and Greater, As of July 1, 2004 (Tonnage in Thousands)

Country	No.	Tanker DWT	No.	Dry Bulk DWT	No.	Full Container DWT	No.	Other* DWT	No.	Total DWT
Greece	857	71.079	1,334	77,711	157	5,498	575	6,162	2,923	160,450
Japan	797	40,469	869	54,937	218	8,002	829	7,756	2,713	111,163
Germany	249	10,295	171	7,709	945	26,750	893	6,596	2,258	51,351
China	327	9,216	630	26,756	223	4,871	989	8,057	2,169	48,900
Norway	393	25,658	166	8,636	14	487	488	7,063	1,061	41,844
United States	371	28,390	76	3,242	89	3,105	395	4,837	931	39,574
Hong Kong	154	14,505	233	19,358	41	1,770	114	1,721	542	37,354
South Korea	238	8,566	188	13,524	106	2,361	269	1,642	801	26,093
United Kingdom	173	8,876	95	8,115	115	4,790	238	2,393	621	24,174
Singapore	324	14,487	123	5,130	134	3,076	116	1,064	697	23,757
Taiwan	41	3,741	186	12,351	184	6,654	121	983	532	23,730
Denmark	154	6,388	29	1,770	130	6,817	179	1,022	492	15,997
Russia	422	9,083	120	1,926	24	329	1,107	4,422	1,673	15,762
India	125	8,335	101	4,128	3	87	53	274	282	12,824
Italy	244	5,925	49	3,499	11	227	162	2,320	466	11,971
Saudi Arabia	78	11,584	1	2	-	-	18	305	97	11,891
Malaysia	128	6,373	40	1,946	34	695	87	511	289	9,524
Iran	36	6,321	45	2,051	10	285	36	659	127	9,316
Turkey	88	1,406	133	5,277	30	336	297	1,749	548	8,769
Switzerland	36	1,016	30	1,335	126	5,001	74	906	266	8,258
All other	2,269	61,488	1,240	50,684	503	12,063	5,535	31,651	9,547	155,883
Grand Total	7,504	353,200	5,859	310,088	3,097	93,204	12,575	92,094	29,035	848,586

* Roll-on/Roll-off, Passenger, break bulk ships, partial containerships, refrigerated cargo ships, barge carriers, and specialized cargo ships.
Source: U.S. Maritime Administration – www.marad.dot.gov